ENVIRONMENTAL IMPACT ON CHANGING CROPPING PATTERN IN ETAH DISTRICT

ABSTRACT
THESIS

SUBMITTED FOR THE AWARD OF THE DEGREE OF

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By

MASIHULLA KHAN

Under the Supervision of

Prof. AZIMUDDIN QURESHI
(Chairman)

DEPARTMENT OF GEOGRAPHY
ALIGARH MUSLIM UNIVERSITY
ALIGARH (INDIA)

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ABSTRACT

ENVIRONMENTAL IMPACT ON CHANGING CROPPING PATTERN IN ETAH DISTRICT

Agriculture in India dates back to the remote past, ever since it has continued to be the leading occupation and the mainstay of the people of the country. About three-fourths of the population of the country lives in the villages, carries out agricultural, and allied activities.

Primitive tillage farming in all parts of the world is, and in the past has always been, associated with a simple sequence of cropping. In the typical case a section of grass or light scrub-covered land is cleared and cropped with same or similar crops until it ceases to yield the profitable returns, either because of exhaustion of fertility or because of accumulation of weeds. In the former case, the cultivators move on and break up another virgin areas., in the latter case same practice may be adopted on a bare fallow or may be introduce to kill the weeds ,after which the land is cropped as before. The former practice was probably adopted by in primitive times in India. As the needs of the community increases and farming become more intensive some definite sequence is adopted. Thus in the manorial period of this country "when each man had his rood of land" different cropping patterns were adopted. At the present time most of the farmers, when asked what rotation they adopt, will reply that they follow no fixed rotation, but at the same time, when further questioned, they will agree that they adhere to more or less closely to an orderly sequence which is capable of alternative application, as circumstances seem so warrant.

Before we are in position to appreciate the value of new cropping pattern, according to some agricultural economist, cropping pattern

means the proportion of area under various crops at a point of time. Quite often the area statistics are used to denote the cropping pattern, no doubt, farmers have evolved the present cropping patterns after centuries of experiences, may be better, but from the national point of view, it is not necessarily the most efficient use of land and other resources. Historically, these cropping pattern were based on the principle of self sufficiency in all commodities in a village where means of communication were very poor and dependence on marketing agency very much limited. Moreover, no cropping pattern can hold good for all times to come. It has to change with improvement in technology and economic factor.

Cropping pattern means both space and time sequence of crops. It includes the intensification of the most efficient crops of the region which is considered a homogenous soil and climatic characteristics, the rotation in which the crop fits in and the intensity of cropping[1]. Thus the term cropping pattern is used in more comprehensive sense when we discuss in term of cropping pattern for farmers it will mean even cropping scheme and cropping intensity best suited to the farmers.

The importance of agriculture has been further underlined by the fact that the population of the country is increasing at a very fast rate, exerting a great pressure on land and adversely affecting the man-land ratio. As a result of cultivation of land over centuries, and as a result of increasing pressure of population on it, the chances of adversely affecting the land in particular and environment in general are also favourable. Thus there is a situation where the land has to be used with great care and where agriculture has to be evolved taking in to cognizance all the environmental and socio-economic factors. Only scientifically and intelligently, agricultural practices can meet the situation. This is possible only when the existing conditions, practices and the changes which are taking place are studied in a considerable

manner then this study in the district of Etah over the period of twenty five years could be more meaningful.

STUDY REGION:

The district of Etah lies in the central portion of the Ganga-Yamuna *doab*, and is bounded on the north by the Ganga which seprate it from the Budaun district; on the west by the districts Aligarh, Mathura and Agra; on the south by the districts of Agra, Firozabad and Mainpuri; on the east by the district of Farrukhabad. The district lies between the parallels of 27°18' and 28°2' north latitudes, and 78° 11' and 79°17' east of longitude. The administrative configuration of the district Etah, as defined in the census of 1991, has been taken as the base for the present research work. The data taken from the district Etah is for the same administrative configuration as in 1991 census, throughout the period under study. This was necessary for making a comparative analysis of the change in the cropping patter and environmental impact on it at the block level for the period under review. As per 1991 census, the administrative configuration of the district Etah comprised of five *tehsil* i.e. Etah, Kasganj, Patiali, Jalesar and Aliganj and fifteen development blocks i.e. Soron, Kasganj, Amanpur, Sahawar, Ganjdundwara, Patiali, Sirpura, Jalesar, Awagarh, Marehra, Nidhauli Kalan, Sheetalpur, Sakeet, Jaithra and Aliganj.

The district is subject to wide rainfall fluctuations from year to year and from season to season. Annual precipitation varies between 400 mm to 900 mm. It decreases from north east to south west directions. The average rainfall in the district during 1950 – 2000 was 700.5 mm. Better irrigation facilities and good alluvial soils bestowed the area with better opportunities for the high level agricultural development. Wheat-pearl millet and wheat-maize cropping system has emerged as the dominant agricultural system after the introduction of Green Revolution. Due to the fluctuations in rainfall and availability of fresh ground water

and well developed canal system, farmers depend on ground water for irrigation

With a population of 2,244,998 as per 1991 census, district ranks 32nd among the districts of U.P. The economy of the district is based primarily on agricultural activities. The district's industrial base has remained agro-based. The main commercial activity of district is trade in grains.

STATEMENT OF RESEARCH PROBLEMS:

Crop production strategy followed in Post Green Revolution Period has considerably helped to expand food (cereal) output and their stocks in India. However, there are a number of other unfavourable trends in this progress that need attention to avert both complacency and deep crises. Serious doubts have been expressed in different quarters regarding suitable cropping pattern and technological progress. The strategy has made food production more unstable. Further, nearly 35 per cent of the rural people or 31 per cent of the overall population is still below the poverty line. The production of pulses and course grains is far from satisfactory. These unsatisfactory trends despite technological changes reflect that appropriate changes have not been made in the institutional and policy environment either before or after introducing technological changes. This does not mean that technological change should await appropriate institutional and policy environment change. The former may help bring about the latter and both should be pursued simultaneously. During Post Green Revolution period institutional changes like land reforms received low priority. The expansion of infrastructure like irrigation, drainage, transportation, market, rural electrification etc. was made mostly in developed regions (denying the expansion of the base of agriculture to the less developed, small and medium farmers). There is concentration of individual crops, of inputs and mechanization subsidies, positive price policies of crops grown in

developed regions and large farms. A considerable number of farmers (small and marginal), areas (resource deficient like unirrigated areas), people, mostly the agricultural labourers, crops and enterprises (coarse cereals, pulses, and oilseeds) were bypassed.

In order to account for the shifting of cropping pattern resulting from techno-organizational changes, a more dynamic conceptualization of changing cropping pattern is required. Such concept should capture the extent to which environment and economic changes are influencing the capacity of the farmers to various types of natural and socio-economic shocks. While the climatic changes may influence the biophysical vulnerability of Indian farmers, on going economic reforms may expose other type of vulnerabilities. With regard to agriculture, the main rational for economic reforms in India are to remove distortions and create an appropriate structure for increasing agricultural production. However, the short-term and medium-term impact of these reforms may not be exclusively beneficial. For consumers, increase in relative prices for food grains could worsen the conditions of the poorest in both rural and urban areas, exacerbating problems of food security for the most vulnerable sector of the population.

The effect of infrastructural development are also likely to vary across agriculture region in India; particularly irrigation technology, fertilizers and mechanical appliances. In areas, where investments in agricultural infrastructure have lagged, rates of growth in the agricultural productivity and poverty reduction also lagged [2]. Climate change may further exacerbate these regional differences, because regions with limited irrigation infrastructure are also the areas where agriculture is most vulnerable to climate variability and change.

The problem that the author has studied is the change in agricultural land use. The major agricultural land use categories: fallow land, net sown area and gross sown area; keep on changing their

acreage. This has a direct bearing on agriculture. The locational change that takes place in these categories also has a bearing on agriculture. These changes, therefore, have been investigated in the district of Etah, and at six inter-decennial points of time.

AIMS AND OBJECTIVES OF STUDY:

The objective of the proposed research is a systematized and improved understanding of the dynamic forces which induced changes in the cropping patterns. Obviously, these forces broadly involve a dual effort: first defining the basic geography of change and its behavior in terms of rate of acceleration and deceleration, and, secondly, a search for the type's factors that have set discovered changes in motion. In very real sense, of course, individual crop in any agricultural region is in a state of essential competition with one another for the favour of farmer and for a place. However, some more objectives of the study are as follows:

1- **To examine the dynamics and trends of crop land use and irrigated land in the Etah district.**

2- **To examine the spatio-temporal changes in the cropping pattern.**

3- **To bring out the spatio-temporal variations in agricultural land use efficiency.**

4- **To assess the levels of agricultural development with the help of selected indicators.**

5- **To assess the spatial patterns of agriculture and its level of modernization,**

6- **To suggest the suitable strategies for sustainable agricultural development.**

HYPOTHESIS:

1- **Spread of technology leads to the change in cropping pattern and cropping intensity.**

2- **Higher the level of irrigation facilities, leads to the higher the level of cropping intensity.**

3- **As the technological advancement goes on, the farmers turn from subsistence farming to commercial farming.**

4- **Through the technological advancement higher giving return crops prefer more and low return giving crops depressed e.g. coarse crops.**

5- **Higher level of agricultural development (unsustainable development), leads to higher level of environmental degradation.**

DATABASE AND RESEARCH METHODOLOGY:

I- DATABASE:

The study is based on the analysis of statistical data covering the period during 1950-51 to 1965-66 for the analyses of cropping pattern, prior to the introduction of green revolution and post period during 1975 to 2000, collected from both primary and secondary sources at block and village level. The primary data were collected through well prepared questionnaire, taking in to account of all the variables related to agricultural development and cropping pattern. The village level information was collected from the selected respondents and *Grampradhan* (Village Head), *Sarpanches* and *Gram Vikas Adhikaries* (Village development officers) of the sample households and villages

located in different soil characteristics and nearness to the roads and towns.

a- SOURCES OF SECONDARY DATA:

For the present study the secondary data has been obtained from the published literature, government reports and district statistical bulletins, daily and weekly news papers, and unpublished records of the public administration and semi-governmental agencies. The sources of secondary data utilized in the present study are listed in the fallowing:

1-Survey of India Toposheets.

2-Census of India Statistics.

3-District Gazetteers of Etah.

4-State Administration Statistical Bulletin.

5-Village and Town Directories of District Etah.

6-District Census Hand Book of Etah.

7-District Statistical Magazine of Etah.

8-Departmental District Head Office Records.

9-Uttar Pradesh Agricultural Statistical Bulletin.

10-News Paper and other Periodicals.

11-District Department of Revenue.

II- METHODOLOGY:

The qualitative and quantitative techniques have been used for the analyses of the present study which are as follows:

I- Descriptive approach has been adopted to describe the physico-cultural characteristics of the study area.

II- For the climatic description the moisture index has been calculated through the formula as under:

Moisture Index =100S-60Q/PE

Where S = the surplus of water

Q = the deficit of water

PE = is water need or potential evapotrnspiration which calculated on the basis of the fallowing formula [3]:

$$e = 1.6\ (10t / I)^a$$

Where, e = monthly evapotranspiration

t = monthly temperature in ^{0}C.

I = summation of 12 monthly heat index $[(t/s)^{1.514}]$

$a = 0.00000675\ I^3 + 0.0000771I^2 + 0.01792\ I + 0.49239$

III- Ranking of crops is done by employing critical difference technique.

IV- Weaver's minimum deviation method has been used to find out the different crop combinations. On Formula as given below [4]:

$$\mathbf{d = d^2 / n}$$

By calculating the deviation from the real percentage of crops for all possible combinations in the compound area units against theoretical values.

V- To work out the relation of changing cropping pattern and the irrigation facilities regression has been calculated as given below:

$$\mathbf{Y = a + bx}$$

VI- Techniques of composite Z score has been employed to determine the levels of the spread of green revolution and correlation between change in cropping pattern and the speed of green revolution technology.

Standard score ('Z' Score), is represented by

$$Z = \frac{X - \overline{X}}{SD}$$

Z = Standard score

X = original values of the score

$\overline{X}$ = Mean for all the values

SD = Standard deviation of X

LITERATURE REVIEW:

The utilization of land for agriculture is conditioned not only on physical and biological factors but also upon the social, cultural and economic value of agricultural activities. Historically, the old world and new world agricultural activities differed probably resulting from the process of human migration (Grigg, 1974, 1992). More recently, a five pronged systematic approach uses the fallowing criteria: location, ecology; social and cultural factors; technology; economic framework; physical structure and landscape (Avlan & Eder, 1986).A combination of

physical, biological and social factors combine togather determine the type of crop which is found in each system.

Scholars from various fields' viz., geography, agricultural economics and ecology have shown a keen interest on the studies of changing cropping pattern. The process and techniques involved in the changing pattern of crop land use have been studied by many scholars viz., Weaver (1954); Shafi (1965) and Singh(1976).Some geographers have studied the implications of new technology in the changing cropping pattern. Quite a few of them have also tried to study the efficiency of agriculture in different areas viz., Mitra (1964); Pal (1962); and Rao (1973). Shafi (1960) in his article has tried to measure the agricultural productivity of great plain. Swafi 1991 studies; Relative magnitude of impacts of crops on different components of the environment, (1) Crop Erosion (risk and contribution), Nutrient loss (leaching and run-off), Water use (soil moisture depletion), Nutrient demand (impact on soil fertility status) and Pesticide use (impacts on biodiversity and pollution). Batterbury, Forsth and Thomson have studied in 1997 about Environmental Transformation in Developing Countries: hybrid research and democratic policy.

Some researchers have studied the impact of globalization on changing agriculture viz., Mwandire (environmental report 1999). The broad assumption of this study is that environmental change and degradation were already taking place in most parts of Malawi; Nsipe included, but were accelerated by a combination of market liberalization and other driving forces. The study carried out in Nsipe Extension Planning Area (EPA) focused on smallholder agricultural production. Environmental change in an agricultural setting was viewed as exhibiting itself through land use and land cover change as well as increased levels of chemical pollution in surface water bodies. The Nsipe EPA study sought to provide an in-depth analysis of the environmental impacts of

cash cropping by small land holder farmers. One of the guiding assumptions of the introduction of cash crops among smallholder farmers, especially tobacco, was that there would be widespread environmental degradation. In order to counter this obvious impact an environmental monitoring program, known as the Malawi Environment Monitoring Program (MEMP) was put into place. The monitoring program described below sought to understand the environmental impacts of cash crop growing and in particular burley tobacco.

Laster Brown (2000) of the world watch institute have studied about an impending global food crises due to increasing population , increasing purchasing power leading to the more consumption of more animal products increasing damage to the ecological conditions of agriculture , declining per capita availability of land and water and absence of technologies that can further enhance the yield potential of major food crops.[5] Swaminathan (2000) pointed out that India is now in a position to launch an ever green revolution that can help to increase yield , income ,and livelihood per unit of land and water, If we bring about a paradigm shift in our agricultural research and development strategies. The green revolution was triggered by the genetic manipulation of yield in crops such as rice, wheat and maize. The ever green revolution will be triggered by farming system that can help the producers from the available land, water and labor resources with out either ecological or social harms.[6]

Dinar et.al.(1998) have studied the net impact of climate change on agricultural output in India are uncertain, yet specific regions and certain groups of farmers ,particularly those farming on marginal, rain fed lands, are likely to suffer significant damage as a result of climate change[7]. Karen and Bien (1999) have studied the globalization is dramatically transforming the context under which farmers throughout the world participate in the agriculture sector. The changes, in turn,

effect how developing world farmers confront climate variability and adopt long term climate change.[8]

A large number of studies have been conducted on the cropping pattern viz., Ali (1985) for higher return grow *arher* in intercropping system. Jyaraman and Ramiah, et. al. (1988) studies on nitrogen management in maize based intercropping system, Kushwaha (1985) effect of fertilizers on yields of mustered and lentil in intercropping system, Saxena, and Chandel (1986) effect of maize on physico-agronomic attributes of soybean in maize-soybean intercropping system, Singh, Mittal, et.al., (1983) have studies on depletion pattern of soils potassium in pearl millets, wheat rotation .

ORGANIZATION OF STUDY:

The study is thematically organized in to nine chapters. The first chapter is introductory and acquaints the reader with the nature of the research problems, study area, aims and objectives of the study, the hypothesis, data source and research design. The geographical profile of the study area and covering its natural environment is the concern of second chapter. The third chapter represents the background of the cropping pattern before the introduction of green revolution, since 1951. The fourth chapter deals with change in the cropping pattern after the introduction of green revolution at block level, from 1975 to 2000. Various problems arises due to the introduction of green revolution examine in the fifth chapter. Chapter six and seven presents an account of the place of the coarse grains in the cropping pattern and level of diffusion of green revolution at block level in the district of Etah. The chapter is based on inferences drown from the micro level study i.e. at village level, which covers farming characteristics, present cropping pattern and techno-organizational environment of the villages

selected for the study. The ninth and final chapter presents conclusions and puts forward suggestions.

FINDINGS:

Landforms, drainage, soil, climate is the basic environmental factors which sometime separately and sometimes togetherness determines the cropping pattern in the district. But in the present scientifically advanced world there are no necessities everywhere are possibilities, it means man through his technical skills break the natural barriers through the development of irrigation facilities, mechanical appliances, use of fertilizers, recovering of sodic or *usar* land, etc.

The district Etah is one of the most fertile districts of Uttar Pradesh where the new technology of agricultural development was initially introduced in 1970. Since then this district has undergone tremendous changes in the field of agriculture. There has been an increase of net sown area from 302495 hectare in 1975 to 310713 hectare in 1999-2000, Gross cropped area from 446857 hectare to 534051 hectare gross irrigated area from 273202 hectare in 1975 to 412719 hectare in 2000. Fertilizers consumption (NPK) has increased from 23.73 kg per hectare in 1975 to 128 kg, per hectares in 2000. The shallow pump sets per thousands of hectares of net sown area have increased from 36 in 1975 to 215.9 in 2000. The numbers of tractors have gone up to 2.73 per thousand of hectare and 12.6 in 2000. These figures convincingly make Etah district one of the most agriculturally progressing districts of Uttar Pradesh. However, the cropping pattern has not been uniform throughout the district. Hence a modest attempt has been made to asses the changing cropping pattern of the Etah district at the block level for the years of 1975-2000.

The trends in the land use is that more and more land is brought under the plough, more forest land, pasture and grazing land is being

deprived of its vegetative cover. More land is coming indiscriminately under industries and urban activities. Another trend is that with the rise of technological and scientific level of development, those lands which were considered useless are being reclaimed and being brought under agriculture. Soils which were considered unfit are enriched and are ploughed.

The present study has been one of the probing in to dynamic competitive relations of crops in the total crop land since the approach has been through analysing individual crops and crop combination in terms of their relative land occupancy strength. An analysis of the data shows that from time to time changes have taken place in the cropping pattern of the area due to one or the other factors the study spread into two phase i.e. before the introduction of green revolution and after the introduction of green revolution, has established some definite lines of approach to the present cropping patterns which have evolved during the period under study. In many cases, it has been observed that change has been brought about by economic consideration, e.g. low return giving crops (coarse grain crops) replaced by high return giving crops wheat, rice and sugarcane in the area where irrigation facilities are available. It has been observed that in the district Etah the number of crops included in the combination is fairly large and the cropland use diversity quite high.

The present study relating to the changing pattern of crop land use over a period 1950-65 and 1975 to 2000 reveals that wheat has emerged as the first ranking crop in the whole of the district of Etah. This crop has a good share in the combination of area. As it is the staple food crop of not only of the district Etah but whole of the western Uttar Pradesh. Majority of the population prefers to eat wheat with the result the area under wheat has increased gradually. Yield per hectare has also increased with the help of irrigation facilities, and chemical fertilizers.

Prior to introduction of green revolution, more area was given to millets and gram in the district but with the improved economic conditions of the forming community, wheat being a better food crop has become the main diet of the majority of the population. Data reveals that oil seeds, pulses, tobacco, potatoes gained importance in the period after introduction of green revolution, and for the first time tobacco ranked third in the development block of Aliganj. This development block has very much specialized in the cultivation of tobacco fetching good returns.

According to the present study, maize crop is becoming an important crop in the block of Jaithra, Marehra, Patiali, Sirpura, Sheetalpur and Soron, developed irrigation facilities, improvement in the regular supply of manure and chemical fertilizers have helped in the increase of maize cultivation. The increasing market value of superior quality of maize has also been responsible for increase in the cultivated area of maize. Pearl millet remains the second raking crop in most of the development block, Kasganj, Jaithra, Aliganj, Jalesar, Patiali,Soron, Marehra and Nidhaulikalan, due to the quality of soil i.e. Sandy soil. Adequate irrigation facilities and attracting market values provide incentives for increase in the cultivated area. The cultivated area of rice has increase in the development block of Sakeet, Amanpur, Jalesar, Ganjdundwara, Patiali, Sirpura and Sheetalpur, present reveals that rapid rise in urban population in the district Etah calls for an increase in the production of wheat, rice, maize, peas, barley and oil seeds, but wheat has got ascendancy over all the other crops since 1970 because the introduction of high yielding varieties of this crop and the development of supporting factors i.e. irrigation, mechanical appliances and fertilizer which help to mature in a very short period with high production per hectare. One important thing to note here is that the sugarcane acreage decreasing day by day since 1990 because of the delay of payments by the factory owners. Tobacco has not been so

important crop in the cropping pattern of the district Etah but the development block of Aliganj have third rank in its cropping pattern.

An interesting feature emerges from the present study is that the size of land holding being small the farmers are generally interested in producing food grains for their requirements. They would go in for cash crops only after they met their requirements of food grains. It is true that the agriculture of the district Etah being of subsistence type the farmer's community first concern is to cultivate grain crops than cash crops. Thus the need for subsistence crops has traditionally dominated the cropping pattern fallowed by small farmers. But his marginal need for money can not be less than that of the large farmers. The introductions of green revolution technology make easy marginal adjustment in their crop pattern to maximise their income.

The fragmented and uneconomic size of land holding have brought about just agriculture deterioration at the same time have aggravated poverty of formers. Another drawback in the small size of land holding is that it initiate against the use of form machinery e.g. harvester etc. from the present study it is gathered that the farmers like that the combination of crops which would ensure him maximum income. The relative profitability per hectare is the main consideration which influences the cropping pattern. So the farmer is influenced in the choice of his crops by the consideration which relates to the price parities between different commodities or maximization income per hectare which in turn effect to the coarse gains.

It has been realized that the presence of saline salt in soil affect the cropping pattern in the region to a considerable extent. If some steps are taken to grow leguminous crops, these crops then will help in neutralising the salt and in the recuperation of soil fertility. Reclamation work should be undertaken by the govt. agencies.

Another factor which requires some consideration is that the soils in the entire region are generally deficient in nitrogen and therefore besides applying nitrogen through chemical manures some leguminous crops, which instead of depleting soil fertility, help in increasing nitrogen in sufficient quantity. In addition to this sun hemp and *Dhencha* are the two important crops which can be cultivated in all adverse conditions of soil and climate.

The structure of cropping pattern in whole of Uttar Pradesh in general and in the district Etah in particular is based on adopting trial and error methods, and hence unscientific .in the present set of physical and cultural environment, some suitable areas for cultivation of remunerative crops could be explored. Besides multiple cropping systems under proper guidance of agricultural experts can be adopted. At least four crops such as wheat, green gram, maize and potato can be grown in a year from one field. Although the multiple cropping systems are exhaustive, proper watering and manuring can make it possible.

Examining the various factors influencing cropping pattern, it has been observed that besides the physical and socio economic factors, have greatly influenced the cropping pattern in the area where least consideration in given to the suitability of the soil for a particular crop. In the light of the present study it may be remarked that the area needs a detailed survey of the soil, so that the new cropping pattern could be evolved which may ensure batter prospects for an overall improvement in the agricultural economy of the area.

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Dedicated

to the

Farmers of

Etah District

AZIMUDDIN QURESHI
Professor & Chairman

DEPARTMENT OF GEOGRAPHY
ALIGARH MUSLIM UNIVERSITY
ALIGARH – 202 002, INDIA

Date: 22-08-2003

Certificate

This is to certify that the thesis entitled "Environmental Impact on Changing Cropping Pattern in Etah District" has been written by Mr. Masihulla Khan and it is his original work.

I have gone through this thesis and is being submitted under my Supervision.

Supervisor
(Azimuddin Qureshi)

Phone – Office.:0091-571-700683, Res. 0091-571-708435, Fax: 0091-571-700683, E-mail: azim qureshi2@rediffmail.com

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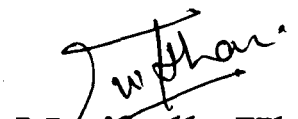

Masihulla Khan

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Chapter- 1

Introduction

INTRODUCTION

Agriculture in India dates back to the remote past, ever since it has continued to be the leading occupation and the mainstay of the people of the country. About three-fourths of the population of the country lives in the villages, carries out agricultural, and allied activities.

Primitive tillage farming in all parts of the world is, and in the past has always been, associated with a simple sequence of cropping. In the typical case a section of grass or light scrub-covered land is cleared and cropped with same or similar crops until it ceases to yield the profitable returns, either because of exhaustion of fertility or because of accumulation of weeds. In the former case, the cultivators move on and break up another virgin areas., in the latter case same practice may be adopted on a bare fallow or may be introduce to kill the weeds ,after which the land is cropped as before. The former practice was probably adopted by in primitive times in India. As the needs of the community increases and farming become more intensive some definite sequence is adopted. Thus in the manorial period of this country "when each man had his rood of land" different cropping patterns were adopted. At the present time most of the farmers, when asked what rotation they adopt, will reply that they follow no fixed rotation, but at the same time, when further questioned, they will agree that they adhere to more or less closely to an orderly sequence which is capable of alternative application, as circumstances seem so warrant.

Before we are in a position to appreciate the value of new cropping pattern, according to some agricultural economist, cropping pattern means the proportion of area under various crops at a point of time. Quite often the area statistics are used to denote the cropping pattern, no doubt, farmers have evolved the present cropping patterns after centuries of experiences, may be better, but from the national point of view, it is not necessarily the most efficient use of land and other resources. Historically, these cropping pattern were based on the principle of self sufficiency in all commodities in a village where means of communication were very poor and dependence on marketing agency very much limited. Moreover, no cropping pattern can hold good for all times to come. It has to change with improvement in technology and economic factor.

Cropping pattern means both space and time sequence of crops. It includes the intensification of the most efficient crops of the region which is considered a homogenous soil and climatic characteristics, the rotation in which the crop fits in and the intensity of cropping[1]. Thus the term cropping pattern is used in more comprehensive sense when we discuss in term of cropping pattern for farmers it will mean even cropping scheme and cropping intensity best suited to the farmers.

The importance of agriculture has been further underlined by the fact that the population of the country is increasing at a very fast rate, exerting a great pressure on land and adversely affecting the man-land ratio. As a result of cultivation of land over centuries, and as a result of increasing pressure of population on it, the chances of adversely affecting the land in particular and environment in general are also favourable. Thus there is a situation where the land has to be used with great care and where agriculture has to be evolved taking in to cognizance all the environmental and socio-economic factors. Only

scientifically and intelligently, agricultural practices can meet the situation. This is possible only when the existing conditions, practices and the changes which are taking place are studied in a considerable manner then this study in the district of Etah over the period of twenty five years could be more meaningful.

STUDY REGION:

The district of Etah lies in the central portion of the Ganga-Yamuna *doab*, and is bounded on the north by the Ganga which seprate it from the Budaun district; on the west by the districts Aligarh, Mathura and Agra; on the south by the districts of Agra, Firozabad and Mainpuri; on the east by the district of Farrukhabad. The district lies between the parallels of 27°18' and 28°2' north latitudes, and 78° 11' and 79°17' east of longitude. The administrative configuration of the district Etah, as defined in the census of 1991, has been taken as the base for the present research work. The data taken from the district Etah is for the same administrative configuration as in 1991 census, throughout the period under study. This was necessary for making a comparative analysis of the change in the cropping patter and environmental impact on it at the block level for the period under review. As per 1991 census, the administrative configuration of the district Etah comprised of five *tehsil* i.e. Etah, Kasganj, Patiali, Jalesar and Aliganj and fifteen development blocks i.e. Soron, Kasganj, Amanpur, Sahawar, Ganjdundwara, Patiali, Sirpura, Jalesar, Awagarh, Marehra, Nidhauli Kalan, Sheetalpur, Sakeet, Jaithra and Aliganj.

The district is subject to wide rainfall fluctuations from year to year and from season to season. Annual precipitation varies between 400 mm to 900 mm. It decreases from north east to south west directions. The average rainfall in the district during 1950 – 2000 was 700.5 mm. Better irrigation facilities and good alluvial soils bestowed

the area with better opportunities for the high level agricultural development. Wheat-pearl millet and wheat-maize cropping system has emerged as the dominant agricultural system after the introduction of Green Revolution. Due to the fluctuations in rainfall and availability of fresh ground water and well developed canal system, farmers depend on ground water for irrigation

With a population of 2,244,998 as per 1991 census, district ranks 32nd among the districts of U.P. The economy of the district is based primarily on agricultural activities. The district's industrial base has remained agro-based. The main commercial activity of district is trade in grains.

STATEMENT OF RESEARCH PROBLEMS:

The Crop production strategy followed in Post Green Revolution Period has considerably helped to expand food (cereal) output and their stocks in India. However, there are a number of other unfavourable trends in this progress that need attention to avert both complacency and deep crises. Serious doubts have been expressed in different quarters regarding suitable cropping pattern and technological progress. The strategy has made food production more unstable. Further, nearly 35 per cent of the rural people or 31 per cent of the overall population is still below the poverty line. The production of pulses and coarse ~~course~~ grains is far from satisfactory. These unsatisfactory trends despite technological changes reflect that appropriate changes have not been made in the institutional and policy environment either before or after introducing technological changes. This does not mean that technological change should await appropriate institutional and policy environment change. The former may help bring about the latter and both should be pursued simultaneously. During Post Green Revolution period institutional changes like land reforms received low priority. The expansion of

infrastructure like irrigation, drainage, transportation, market, rural electrification etc. was made mostly in developed regions (denying the expansion of the base of agriculture to the less developed, small and medium farmers). There is concentration of individual crops, of inputs and mechanization subsidies, positive price policies of crops grown in developed regions and large farms. A considerable number of farmers (small and marginal), areas (resource deficient like unirrigated areas), people, mostly the agricultural labourers, crops and enterprises (coarse cereals, pulses, and oilseeds) were bypassed.

In order to account for the shifting of cropping pattern resulting from techno-organizational changes, a more dynamic conceptualization of changing cropping pattern is required. Such concepts should capture the extent to which environment and economic changes are influencing the capacity of the farmers to various types of natural and socio-economic shocks. While the climatic changes may influence the biophysical vulnerability of Indian farmers, on going economic reforms may expose other type of vulnerabilities. With regard to agriculture, the main rationale for economic reforms in India are to remove distortions and create an appropriate structure for increasing agricultural production. However, the short-term and medium-term impact of these reforms may not be exclusively beneficial. For consumers, increase in relative prices for food grains could worsen the conditions of the poorest in both rural and urban areas, exacerbating problems of food security for the most vulnerable sector of the population.

The effect of infrastructural development are also likely to vary across agriculture region in India; particularly irrigation technology, fertilizers and mechanical appliances. In areas, where investments in agricultural infrastructure have lagged, rates of growth in the agricultural productivity and poverty reduction also lagged [2]. Climate

change may further exacerbate these regional differences, because regions with limited irrigation infrastructure are also the areas where agriculture is most vulnerable to climate variability and change.

The problem that the author has studied is the change in agricultural land use. The major agricultural land use categories: fallow land, net sown area and gross sown area; keep on changing their acreage. This has a direct bearing on agriculture. The locational change that takes place in these categories also has a bearing on agriculture. These changes, therefore, have been investigated in the district of Etah, and at six inter-decennial points of time.

AIMS AND OBJECTIVES OF STUDY:

The objective of the proposed research is a systematized and improved understanding of the dynamic forces which induced changes in the cropping patterns. Obviously, these forces broadly involve a dual effort: first defining the basic geography of change and its behavior in terms of rate of acceleration and deceleration, and, secondly, a search for the type's factors that have set discovered changes in motion. In very real sense, of course, individual crop in any agricultural region is in a state of essential competition with one another for the favour of farmer and for a place. However, some more objectives of the study are as follows:

1- **To examine the dynamics and trends of crop land use and irrigated land in the Etah district.**

2- **To examine the spatio-temporal changes in the cropping pattern.**

3- **To bring out the spatio-temporal variations in agricultural land use efficiency.**

4- **To assess the levels of agricultural development with the help of selected indicators.**

5- **To assess the spatial patterns of agriculture and its level of modernization,**

6- **To suggest the suitable strategies for sustainable agricultural development.**

HYPOTHESIS:

1- **Spread of technology leads to the change in cropping pattern and cropping intensity.**

2- **Higher the level of irrigation facilities, leads to the higher the level of cropping intensity.**

3- **As the technological advancement goes on, the farmers turn from subsistence farming to commercial farming.**

4- **Through the technological advancement higher giving return crops prefer more and low return giving crops depressed e.g. coarse crops.**

5- **Higher level of agricultural development (unsustainable development), leads to higher level of environmental degradation.**

DATABASE AND RESEARCH METHODOLOGY:

I- DATABASE:

The study is based on the analysis of statistical data covering the period during 1950-51 to 1965-66 for the analyses of cropping pattern, prior to the introduction of green revolution and post period during 1975 to 2000, collected from both primary and secondary sources at block and village level. The primary data were collected through well prepared questionnaire, taking in to account all the variables related to agricultural development and cropping pattern.

The village level information was collected from the selected respondents and *Grampradhan* (Village Head), *Sarpanches* and *Gram Vikas Adhikaries* (Village development officers) of the sample households and villages located in different soil characteristics and nearness to the roads and towns.

a- SOURCES OF SECONDARY DATA:

For the present study the secondary data has been obtained from the published literature, government reports and district statistical bulletins, daily and weekly news papers, and unpublished records of the public administration and semi-governmental agencies. The sources of secondary data utilized in the present study are listed in the fallowing:

1-Survey of India Toposheets.

2-Census of India Statistics.

3-District Gazetteers of Etah.

4-State Administration Statistical Bulletin.

5-Village and Town Directories of District Etah.

6-District Census Hand Book of Etah.

7-District Statistical Magazine of Etah.

8-Departmental District Head Office Records.

9-Uttar Pradesh Agricultural Statistical Bulletin.

10-News Paper and other Periodicals.

11-District Department of Revenue.

II- METHODOLOGY:

The qualitative and quantitative techniques have been used for the analyses of the present study which are as follows:

I- Descriptive approach has been adopted to describe the physico-cultural characteristics of the study area.

II- For the climatic description the moisture index has been calculated through the formula ~~as under~~ below:

Moisture Index =100S-60Q/PE

Where S = the surplus of water

Q = the deficit of water

PE = is water need or potential evapotranspiration, which is calculated on the basis of the following formula [3]:

$$e = 1.6\,(10t / I)^{a}$$

Where, e = monthly evapotranspiration

t = monthly temperature in ^{0}C. / average ?

I = summation of 12 monthly heat index $[(t/s)^{1.514}]$

$a = 0.00000675\ I^{3} + 0.0000771I^{2} + 0.01792\ I + 0.49239$

III- Ranking of crops is done by employing critical difference technique.

IV- Weaver's minimum deviation method has been used to find out the different crop combinations. On Formula as given below [4]:

$$\mathbf{d = d^{2} / n}$$

By calculating the deviation from the real percentage of crops for all possible combinations in the compound area units against theoretical values.

V- To work out the relation of changing cropping pattern and the irrigation facilities regression has been calculated as given below:

$$\mathbf{Y = a + bx}$$

VI- Techniques of composite Z score has been employed to determine the levels of the spread of green revolution and correlation between change in cropping pattern and the speed of green revolution technology.

Standard score ('Z' Score), is represented by

$$Z = \frac{X - \overline{X}}{SD}$$

Z = Standard score

X = original values of the score

$\overline{X}$ = Mean for all the values

SD = Standard deviation of X

LITERATURE REVIEW:

The utilization of land for agriculture is conditioned not only on physical and biological factors but also upon the social, cultural and economic value of agricultural activities. Historically, the old world and new world agricultural activities differed probably resulting from the process of human migration (Grigg, 1974, 1992). More recently, a

five-pronged systematic approach uses the fallowing criteria: location, ecology; social and cultural factors; technology; economic framework; physical structure and landscape (Avlan & Eder, 1986).A combination of physical, biological and social factors combine togather determine the type of crop which is found in each system.

Scholars from various fields' viz., geography, agricultural economics and ecology have shown a keen interest on the studies of changing cropping pattern. The process and techniques involved in the changing pattern of crop land use have been studied by many scholars viz., Weaver (1954); Shafi (1965) and Singh(1976).Some geographers have studied the implications of new technology in the changing cropping pattern. Quite a few of them have also tried to study the efficiency of agriculture in different areas viz., Mitra (1964); Pal (1962); and Rao (1973). Shafi (1960) in his article has tried to measure the agricultural productivity of great plain. Swafi (1991) studies; Relative magnitude of impacts of crops on different components of the environment, (1) Crop Erosion (risk and contribution), Nutrient loss (leaching and run-off), Water use (soil moisture depletion), Nutrient demand (impact on soil fertility status) and Pesticide use (impacts on biodiversity and pollution). Batterbury, Forsth and Thomson have studied in 1997 about Environmental Transformation in Developing Countries: hybrid research and democratic policy.

Some researchers have studied the impact of globalization on changing agriculture viz., Mwandire (environmental report 1999). The broad assumption of this study is that environmental change and degradation were already taking place in most parts of Malawi; Nsipe included, but were accelerated by a combination of market liberalization and other driving forces. The study carried out in Nsipe Extension Planning Area (EPA) focused on smallholder agricultural

production. Environmental change in an agricultural setting was viewed as exhibiting itself through land use and land cover change as well as increased levels of chemical pollution in surface water bodies. The Nsipe EPA study sought to provide an in-depth analysis of the environmental impacts of cash cropping by small land holder farmers. One of the guiding assumptions of the introduction of cash crops among smallholder farmers, especially tobacco, was that there would be widespread environmental degradation. In order to counter this obvious impact an environmental monitoring program, known as the Malawi Environment Monitoring Program (MEMP) was put into place. The monitoring program described below sought to understand the environmental impacts of cash crop growing and in particular burley tobacco.

Laster Brown (2000) of the World Watch institute have studied about an impending global food crisis due to increasing population , increasing purchasing power leading to more consumption of animal products increasing damage to the ecological conditions of agriculture , declining per capita availability of land and water and absence of technologies that can further enhance the yield potential of major food crops.[5] Swaminathan (2000) pointed out that India is now in a position to launch an ever green revolution that can help to increase yield , income ,and livelihood per unit of land and water, If we bring about a paradigm shift in our agricultural research and development strategies. The green revolution was triggered by the genetic manipulation of yield in crops such as rice, wheat and maize. The ever green revolution will be triggered by farming systems that can help the producers from the available land, water and labor resources with out either ecological or social harms.[6]

Dinar et.al.(1998) have studied the net impact of climate change on agricultural output in India are uncertain, yet specific regions and

certain groups of farmers ,particularly those farming on marginal, rain fed lands, are likely to suffer significant damage as a result of climate change[7]. Karen and Bien (1999) have studied the globalization is dramatically transforming the context under which farmers throughout the world participate in the agriculture sector. The changes, in turn, effect how developing world farmers confront climate variability and adopt long term climate change.[8]

A large number of studies have been conducted on the cropping pattern viz., Ali (1985) for higher return grow *arher* in intercropping system. Jyaraman and Ramiah, et. al. (1988) studied on nitrogen management in maize based intercropping system, Kushwaha (1985) effect of fertilizers on yields of mustered and lentil in intercropping system, Saxena, and Chandel (1986) effect of maize on physico-agronomic attributes of soybean in maize-soybean intercropping system, Singh, Mittal, et.al., (1983) have studies on depletion pattern of soils potassium in pearl millets, wheat rotation .

References:

1- Kanwar, J.S., (1968) 'Cropping Pattern, Scope and Concept', *Proceedings of the Symposium on cropping Pattern in India,* ICAR, New Delhi, p-15.

2- Rao, C.H.H., (1994) 'Agricultural Growth, Rural Poverty and Environmental Degradation in India, Delhi, Oxford University Press.

3- Thornthwaite, C.W., (1948) 'An Approach Towards a Rational Classification of Climate, *Geographical Review,* Vol. 38, p-55

4- Weaver, J.C., (1954) 'Crop Combination Regions in Middle West', *Geographical Review,* Vol. XLVI, No. 4, pp. 173-200.

5- Swaminathan, M.S., (2000) 'For an Ever Green Revolution', *The Hindu,* Survey of Indian Agriculture, pp. 9-15.

6- Dinar, A and Mendelsohn, M, (1998) 'Measuring the Impact of Climate Change on Indian Agriculture', Washington, D.C., The World Bank, rleichen@rci.rutgers.edu.

7- Brien, O., Karen, (1999) 'The Dynamics of Vulnerability to Global Change', karen.obrien@cicero.uio.no

8- Shafi, M., (1965) 'Pattern of Crop Land Use in the Ganga-Yamuna Doab' *The Geographer,* Vol. XXIII, No. 2 ,pp-13-20.

9- Shafi, M. (Oct. 1960) 'Measurement of Agricultural Efficiency in U.P.' *Economic Geography,* Vol. XXXVI, No. 4.

10- Environmental Report, The Impact of Market Liberalization on the Malawian Environment Prepared for the U. S. Agency for International Development by Clark University and the University of Arizona, April 1999.

11- Ali, M., (1985) 'For High Return Grow Arher in Inter-cropping System' *Indian Farming,* Vol. 36(1), pp 7-8.

12- Jeyaraman, S.; Ramiah, S. and Krishna Reddy, (1988) 'Studies on Nitrogen Management in Maize base Inter-cropping System' *Indian journal of Agron.,* Vol. 33, pp 98-19.

13- Kushwaha, B.L., (1985) 'Effect of Fertilizers on the Yield of Mustared and Lentil in the Inter-cropping System' *Indian Journal of Agrono.,* Vol. 30, pp 154-7.

14- Sexna, S.C. and Chandela, A.S., (1986) 'Effect of Maize on Physico-agronomic Attributes of Soyabean in Maize-soyabean Inter-cropping' *Indian journal of Agricultural Science,* Vol. 56, pp 771-5.

15- Singh, R.; Mittal, S.B.; Singh, A.P. and Singh, M., (1983) 'Studies on Depletion Pattern of Soil Potassium in Pearlmillet-wheat Rotation' *journal of Indian Soc. Soil Science,* vol. 31, pp54-9..

Chapter - 2

Physical Setting

PHYSICAL SETTING

PHYSIOGRAPHY:

The district of Etah lies in the central portion of the Ganga - Yamuna doab and is bounded on the north by the Ganga which separates it from Budaun district, on the west by the district of Aligarh, Mathura and Agra, on the south by Agra and Mainpuri and on the east by Farukhabad. The district lies between the parallels of 27^0 18'and 28^0 2' north latitudes and $78^0$11'and 79^0 17' east longitude and is of very irregular shape (fig-1.1). The Jalesar *Tahsil* running out in a long promontory between the adjoining district of Aligarh, Mathura and Agra both Etah, Sakeet and Aliganj. Thrusting out large wedges of their territory in to the Mainpuri district. The total area of the district according to the recent survey is 4446 Sq. Km. The greatest length from South West to North East is 62 miles and from North to South a line drawn through the city Etah measures 43 miles.

The district Etah structurally forms part of upper Ganga plain (Ganga - Yamuna *doab*) which lies between the northern peninsular India and the recently built Himaliyan chain. The geological evolution of the plain remains a matter of discussion. Eduard Suess the Austrian geologist, suggest that the plain is a "fore deep" formed in front of the resistant mass of the peninsula when the Tethyan sediments were thrust southward and compressed against them. According to a second view by Sir Sydney Burrard (Formerly Surveyor –General of India) the plains represent a rift valley bounded by the parallel fault on this region as a sag in the crust formed between the northward drifting

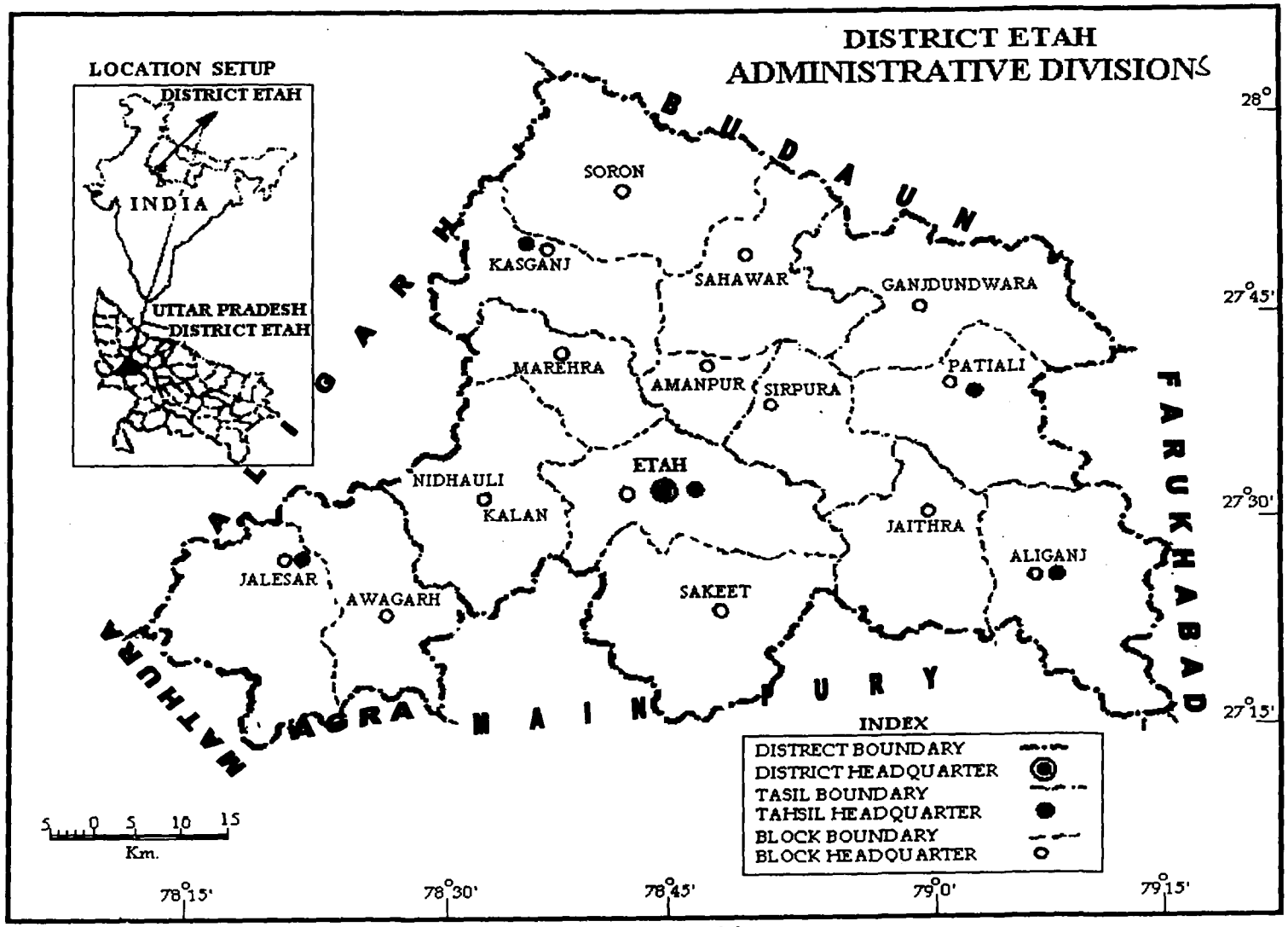


Fig. 2.1

Source: Census of India (1981), Regional Division of India- A Cardiography Analysis-Series-1 Volume-XXII, Uttar Pradesh Map No. 42

India continent and comparatively of sediments accumulated in the Tethyan basin—when the latter were crumpled up and lifted up into a mountain system[1].

The Ganga -Yamuna *doab* is a geomorphologic entity of the surface alluvium which has a thickness of 1000 to 2000 meters.Generally the ~~flat characteristics~~ flatness of the whole districts is evident from the fact that the relative relief varies from 4 to 6 meters only. On the other hand it varies from 6 to10 meters on *bhangar* upland[2] (Fdig-1.2). The Kalinadi flowing from North West to south east divides the district into two parts. The area to the south west of the Kalinadi consisting of the Jaleser and Etah *Tahsils* and comprising less than half of the total area, is a fertile tract of stable cultivation, while the northern portion which include the *tahsil* of Kasganj, Aliganj and Patiali is the reverse, being subjected to the remarkable vicissitudes of fortune and very sensitively to any abnormal variation of season and rainfall.

Topographically there are four distinct tracts –first the *Tarai* or low land between the River Ganga and its old high bank, second the central *doabs*, or the upland between the bank and crest of the Kalinadi bank. Third valley of the Kalinadi and forth in the tract lying on this river.

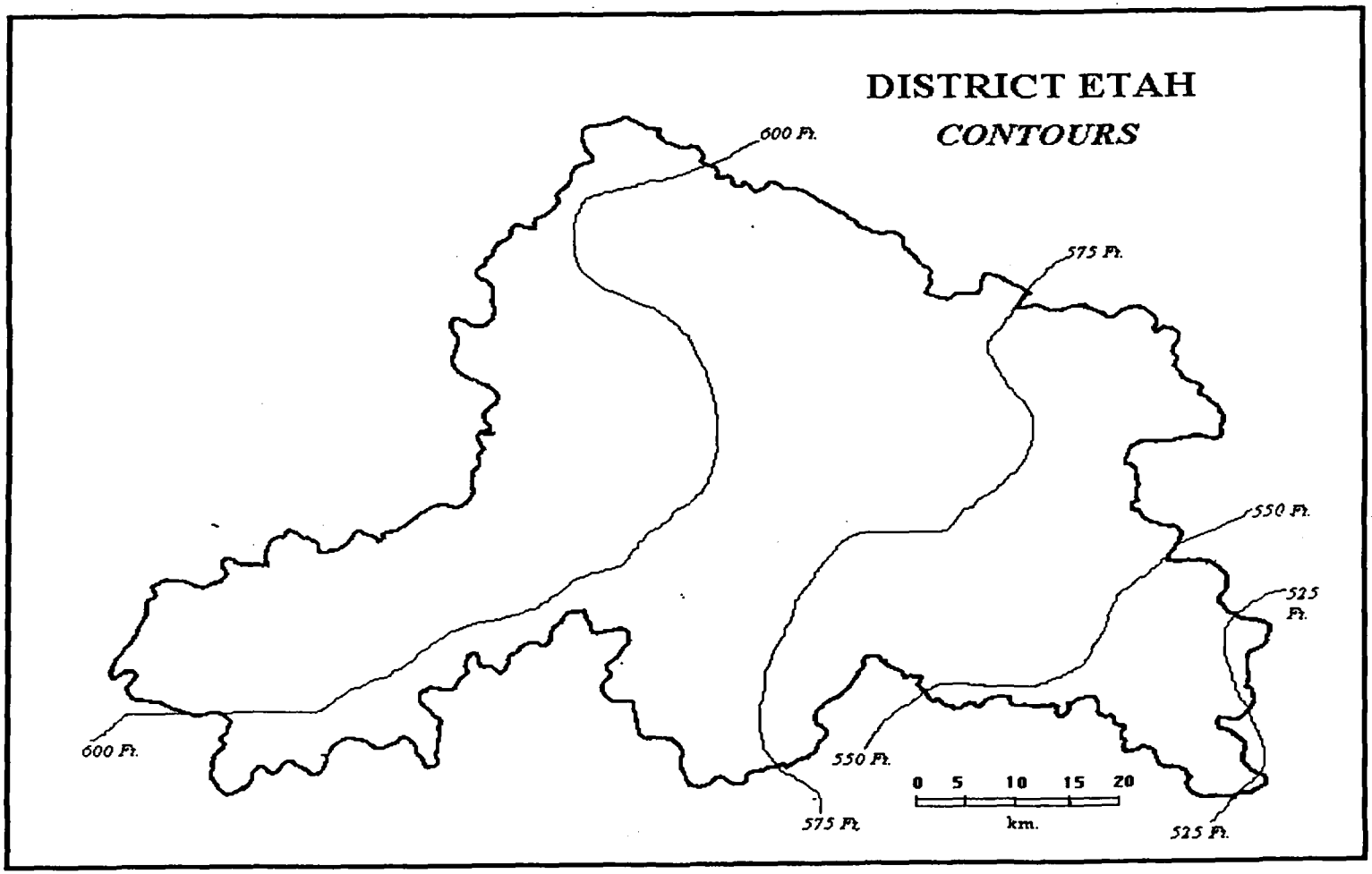
TARAI:

This tract stretches from the bed of the Ganga to its old high bank and at some places is as much as –15 km. in breadth. It comprises the *parganas* of Fiazpur Badaria, Ulai and Nidhpur, more than half of the Soron, one third Patiali and a portion of Pachlana, Sahawar and Azamnagarh. The soils throughout are alluvial character with the difference that they have a larger admixture of vegetable matter than their counter part in the up land. Even where the portion

of the sand is high, they are soft to touch and resemble rather artificial soils, the composite of gardener, than natural earth. The most valuable of the *Tarai* soil is the rich soft loam found along the edge of the Ganga; similar but less valuable soil is met along the edge of the Burhganga (old bed of the Ganga). Here the quality of the soil deteriorates from north to south, being a very sandy just above the Burhganga. South of that stream there is always considerable stretch of very poor soil, either wind blown sand or *usar* (barren land) but towards the high bank there is marked improvement in the soil. The subsoil throughout this tract is sand, the pure white sand of the Ganga bed and the fertility of the given tract depends more upon the depth than quality of the alluvial deposits with which the sand is severed. The surface is everywhere uneven, following through with less marked variation, the contours of the underlying sand, so that the hollows, which were the first to catch alluvial deposits, are richer than the ridges.

CENTRAL DOAB:

This tract comprises the major portion of pargana Pachlana, Bilram, Soron, Sahawar, Sirpura, Birna and Azamnagarh. The character of soil in this tract depends largely upon the distance from the Kalinadi and old high bank of the Ganga. At the western boundary of the district the average distance is about 21 km. The Kalinadi is than running eastward, while the trend of the high bank is to the east with the result that when Sahawar is reached the distance is shrinks about 22 km from that point to the commencement of Berna, it varies from 12 to 16 km. The banks of the river in this tract are marked by a belt of sand and it is well marked characteristics that wherever they approach one another, these ridges stretch out as though to join hands forming an almost continuous sea of sand from one river to the other. Where on the contrary, they diverge.



Source-Geographical Survey of India. Fig- 2.2

The sand seems to shrink in and the center of the tract is occupied by a level plain of loam and *usar*. Elsewhere the surface is uneven sand being pitted with hollows and depression in which water collects, giving rise to a little former soils. The sub-soil in this tract is nearly everywhere sandy. In some places as in the east of Aliganj and near Sahawar, a firm sub-soil is met, but such tracts stand out as entirely distinct from the rest of the *doab*.

KALI NADI VALLEY:

The width of the valley varies according as descent to the low land is gradual and abrupt. On the southern bank and the eastern half of the northern bank of this descent is almost everywhere gradual. But in the western half of the northern bank, the descent is in many places sudden, often with a kind a steppe between the crest and valley bottom. The soil of these steppes is tough sandy yet fertile. The lowest portion of the valley is that at the foot of the high bank where the soil is always rich, but liable to swamping. This is especially the case where the drainage channels from the upland make their way down. The soil on the immediate margin of the stream is a good loam, well raised and not very step. Some times soil similar to that on the river bank extents nearly to the up land. This is more often the case in the west than in the east. However the central part is inferior to the rest of the valley, if raised, it is sandy and if low line, it is infected with *reh*.

SOUTHERN TRACT:

The tract south of the Kalinadi comprises Jalesar, particularly the whole Marehra and east Sakeet, Two-third of *Pargana* Sonhar and a portion of Bilram. The tract is distinguished by the absence of sandy soil, and is also the most stable. The prevailing soil is a good loam. As we proceed towards the Isan, which runs through the southern portion of Marehra and Etah Sakeet, the soil becomes stiffer and clay is more

frequent. On the opposite side of the Isan, the rivers are the case. The stiffest soil is in the north, which is followed by good loam and then by lighter loam. The sub soil most part of this tract is firm. In the extreme south-west, however, the level sinks to a marked degree, increasing materially the cost of raising water.

NATURAL DRAINAGE SYSTEM: -

The water available for agriculture in the form of surface water is one of the essential bases and the foundation of farming. Drainage system of any region works like veins in human body. With a poor water supply the otherwise productive lands tilled by assiduous farmers have only an inferior and subsistence farming and a poor living for the peasantry; with sufficient and assured water supply to the same the farming is superior, stable, diversified and commercially profitable and the living of peasant proprietors' affluent. In the areas having meager, concentrated and highly truant rainfall the establishment of prosperous farming begins with the utilization of the water resources by extending and improving the irrigation facilities. An assured and regulated supply of agricultural water from ground and surface resources is the basic and essential aspect upon which the future planning of irrigation depends [3]. Because of the uncertainty in the flow of surface water it is probable that any attempt to improve agricultural techniques and land use planning without combating the problems associated with shallow and deep water table are bound to be abortive.

The chief rivers of the district are (Fig-1.3) the Ganga, theBurhganga the Kali nadi, the Isan , The Rind and the Bagarh river. The general flow of these rivers is from North – West to South – East.

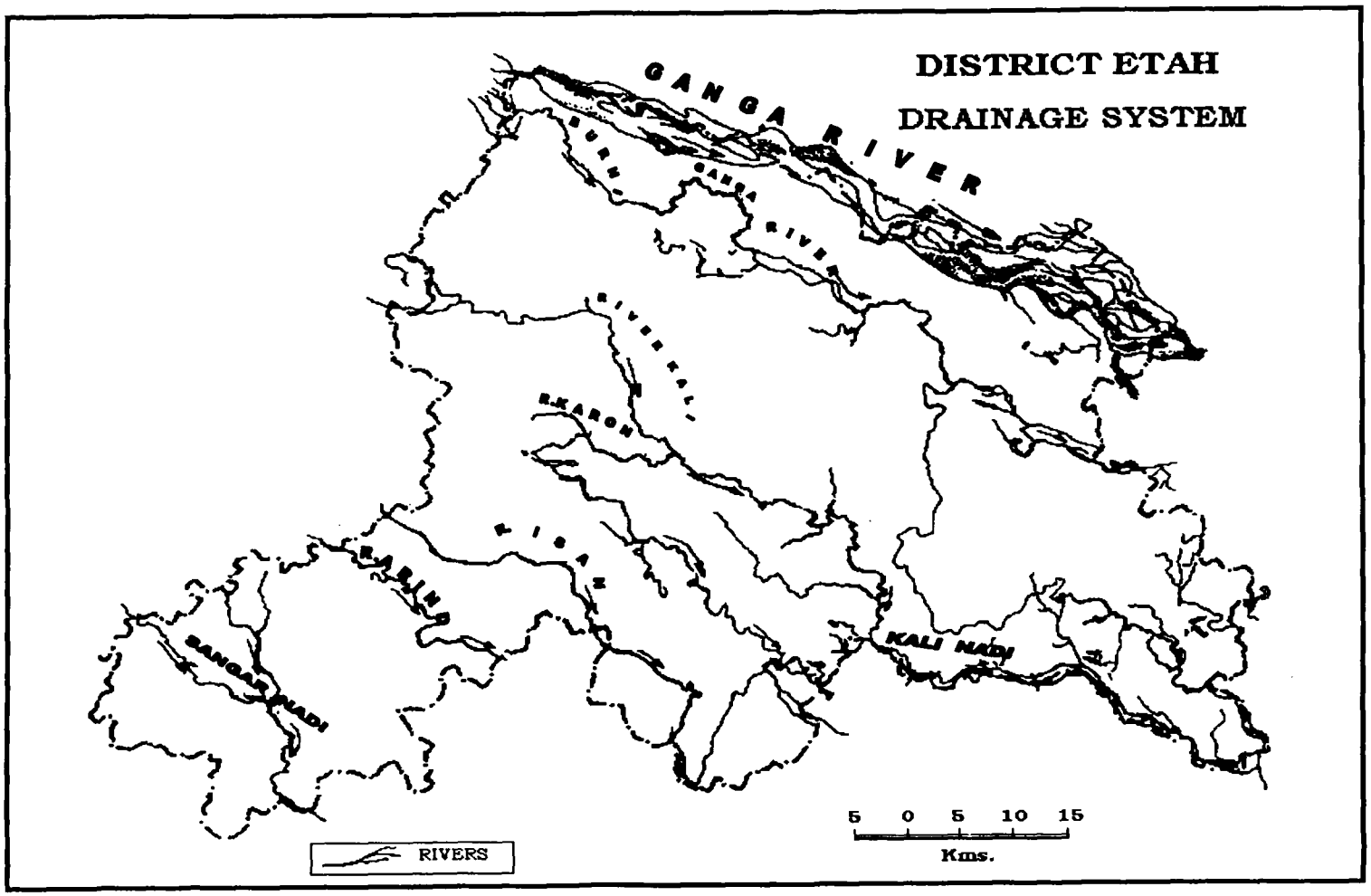


Fig 2.3

Source: Census of India (1981), Regional Division of India- A Cardiography Analysis-Series-1 Volume-XXII, Uttar Pradesh Map No. 42

GANGA:

The Ganga forms for about 51 Km. northern boundary of the district flowing in south easterly direction. The river flows at a distance varying from 5 Km. from its old high bank.

BURHGANGA:

The former bed of the Ganga is marked by the Burhiganga or Burhganga which enters the district from north west corners and flows south eastwards at a considerable distance from the old high bank which is locally known as the *pahar* and has an average height of about 7Km. above the level plain, rising up to 10 to 15 meter and varying considerably in the appearance at different places. Some times it descends with a gentle slope to the low lands in to which it imperceptibly disappear, at other places it raises abruptly like a wall. The current of the Burhganga is sluggish and its course is tortuous, blocked in many places by sand hills and weeds. It is thus unable to cope with rainfall above the normal and floods are common. While the land in its neighborhood are liable to water logging, its bed has been excavated and straightened and is annually infected to keep it clear of weeds by the irrigation department.

KALI NADI:

The kalinadi or kalindi, as it is often called locally, flows to the south of the Burghanga at a distance of 11 Km. to 27 Km. Entering the Etah district from Aligarh in the North West its general trend is to the south east and finally it forms the southern boundary of Aligarh *Tahsil.* Its total length in the district is about 104 Km.. The valley through which the river flows is deep and about 5 Km. in width.

ISAN:

The Isan is apparently the outcome of wide shallow depression ~~which~~ is (said to be traceable from Sardhana in Meerut) down to the border of this district. On the west it is still an ill-defined depression rather a waterway, but it develops a distinct bed about half way across the district. Its level however is never much below that of the surrounding areas. It has not *tarai,* the approach to it being merely marked by extensive stretches of low-lying clay lands.

RIND:

The Rind, Ratwa or Arind flows through portion of the south of the district beyond the Isan and, though a river of considerable size in the rains, in the cold and the hot seasons it almost entirely dries up.

BAGARH:

The Bagarh rises in the north-east of Azamanagarh, where it forms a series of a shallow depression depending occasionally into *Jhils* and ultimately becomes a stream which flows into the Furrukhabad district. It rises up soon after the rains and its bed affords some good *tarai* cultivation.

There are some also small tributaries of the Kalinadi, such as theNim,which flows into it at Baswan near Bilra, The KarohNala, which join the Kali nadi near Mandri, the Karno Nala which falls in to the Kalinadi near Dumari and the Bhongaon Nala, which after passing about 7km. from Aliganj join it near Sarai Agnat.

CLIMATE:

The climate of the district is characterized by a cool winter and hot summer. The year may be divided into four seasons, viz the cold season, running from the middle of November to the whole month of February, followed by the season extending from March to the third

weak of June. The period from the third week of June to about the third week of September constitute the south-west monsoon season and the succeeding period lasting till the middle of November is the post monsoon season.

The three most important factors in climate from the stand point of plant response are temperature, water supply and light, which may be treated as the primary determinants of crop growth[4]. Water supply from the rainfall, the most important variable of these climate parameters is aberrant throughout the state on account of the unpredictable, pulsatry and patchy character of the monsoon. Sunlight controls the onset character of certain biological processes, that, pollinations, flowing, ripening etc., but in the Etah, sunlight is not major factor in accounting for the distribution and pattern of agricultural activities because of its sufficiency. There is a bright sunshine for major parts of the agricultural year. Temperature as such is not a limiting factor in crop growth in Etah.

RAIN FALL:

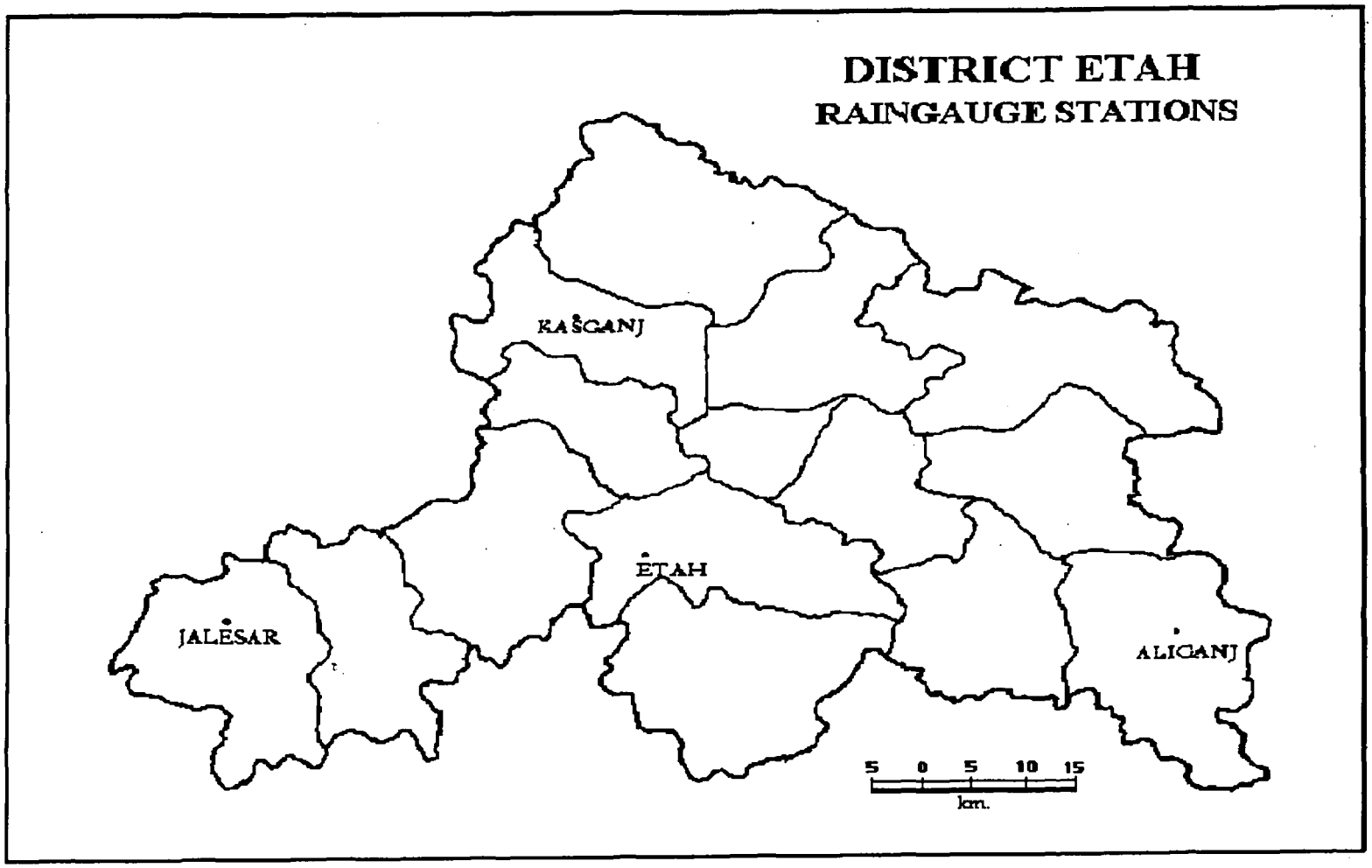
The moisture input in the form of rain is the major ecological determinant for possible and actual farming system in Etah. InEtah, rainfall is the main determinant in the choice of crops. A very clear ecological changes in types of food grains grown is discernible as the rainfall decreases specially in *Kharif* season where the rainfall is sufficient, rice, millets and maize are important crops in the *Kharif* season.In Etah rainfall is the only dominant single weather parameter in farming because of its scantiness, concentration, intensity, variability and unreliability. The ways in which rainfall characteristics affects agriculture need a detailed investigation as it is probable that their operation is more subtle for crops that can be affected by moisture conditions at sowing, germination, shooling and stalking and heading

and at maturing, harvesting and threshing. Moisture is an important factor in all crop-producing areas. It is the all-important factor in the minimal regions, where the average as normal rainfall is generally necessary for the successful crop production. Thus it may be asserted that rainfall*/ is the most important climatic factor influencing agriculture in the district as it undeniably determines the potential of any area in terms of crops to be raised, farming system to be adopted, the nature and sequence of farming operations to be followed, and accomplishment of production per unit area. Finally in association with evapotranspiration, rainfall characteristics make a case either for the necessity and feasibility of irrigation or in favor of no irrigation.

Water resources are a vital organ in practically every aspect of agricultural land use in Etah and being in meager they are an inhabiting factor to agricultural development. Variation in rainfall from year to year is considerable, and, because rainfall is frequently marginal in amount for agriculture and restricted in season, this variability is more critical.

Data on rainfall are more meaningful and sound. Since more rain gauge stations record rainfall than record temperature (fig-1.4). Pattern of annual totals of rainfall shows a marked special differences resulting from the prevalence of easterly-moving monsoon and westerly moving depressions. The rainfall increases from the west towards the east and varies from 60.1cm at the Jalesar to 77.8 cm at Aliganj. (fig-1.5). About 88 percent of the annual rainfall in the disrtict is received during the period from June to September. July and August being the month of heaviest rainfall. Variation in the rainfall is from year to year is large. In the 50 years period 1950 to 2000 the highest annual rainfall in the district amounting to 181 percent of the normal, occurred in 1958.

*/ combined with temperature and wind
"Effective rainfall = total rain - evaporation - runoff ..



Source-District Statistical Department

Fig-2.4

The lowest rainfall, which was 50-percent of the normal, occurred in 1999. In the same span of 50 year, the annual rain fall in the district was between 400 and 900mm. in 30 years out of fifty. A statement regarding the frequency of annual rainfall in the district is given below for the period of 1950-1999

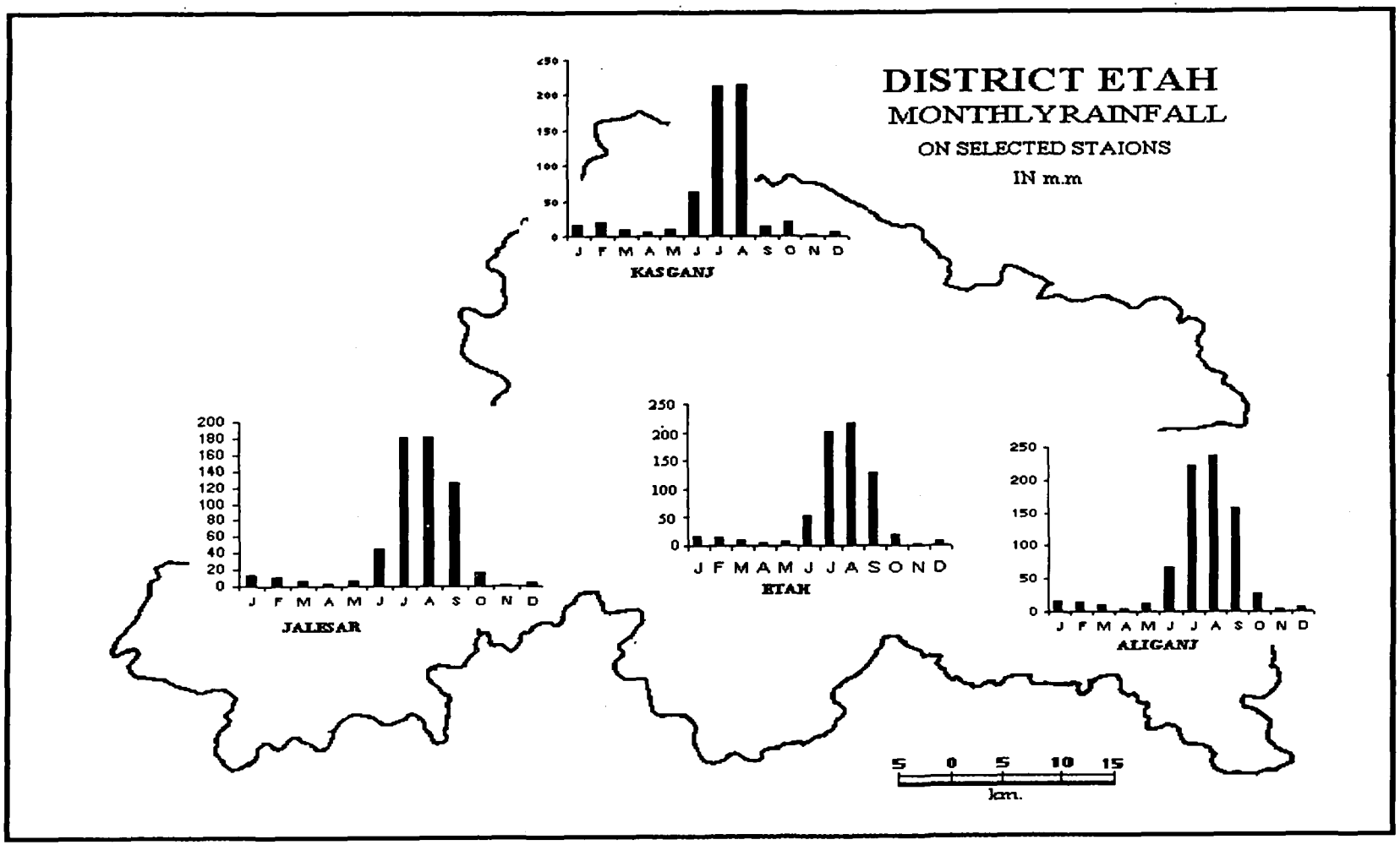
Table-2.1

FREQUENCY OF RAIN FALL

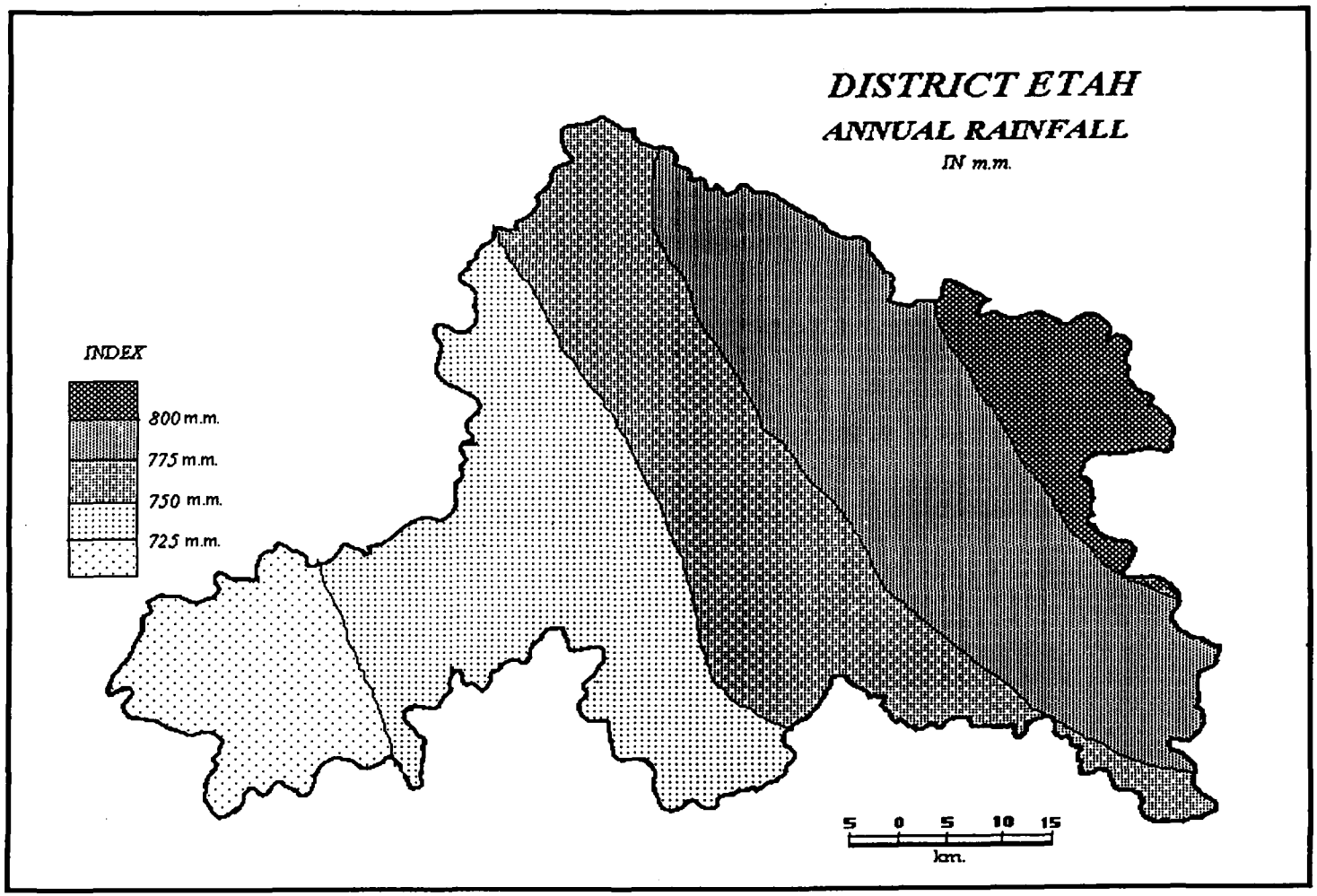
1950 - 1999

Rain in mm	No. of Year
200 to 300	1
301 to 400	3
401 to 500	5
501 to 600	9
601 to 700	11
701 to 800	3
801 to 900	9
901 to 1000	4
101 to 1100	0
1101 to 1200	1
701 to 800	1

Source-District Gazetteer 1980 and District Agriculture department



Source-Metrological Department New Delhi and District Agriculture department Etah Fig.-2.5



Source-District Department of Agriculture Fig.-2.6

On an average there are 37 rainy days (i.e. days with rainfall of 2.5 mm or more) in a year in the district. These numbers of rainy days have recorded ranging from 33 at Jalesar to 38 at Aliganj. The heaviest rainfall in 24 hr. recorded at any station in the district was 281.7 in July 1958 at Kasganj.

TEMPERATURE:

Temperature is far less inconsistent from year to year than the rainfall, but the Etah has great annual range of temperature is highly significant, giving rise to two cropping-seasons viz. *Kharif* (summer) and *Rabi* (winter). Between the major seasons there is a *Zaid*(additional) cropping as well, which is known *rabi-zaid.* For that reason a wide range of crops, tropical, sub tropical and temperate are grown.

There is no meteorological observatory in the district. The description, which follows, ~~is follows~~ is based on the records of the neighboring districts where similar climatic conditions prevail. After February there is a continuous increase in the temperature and May is generally the hottest month of the year. The mean daily maximum temperature in May is about 41^{0}c and the mean daily minimum, about 27^{0}c.

The summer season is intensely hot with the maximum temperature on individual days rising up to 46^{0}C. Hot dry dust laden winds, which blow during the summer, make the weather very uncomfortable. With the onset of monsoon in the district by the third weak of a June, there is rapid decrease in the day temperature due to the increased moisture in the atmosphere even in the monsoon season the weather is oppressive in between the rains. After the withdrawal of the monsoon by about third weak of September there is a rapid decrease in the night temperature while there is slight increase in the

day temperature. It is only after October that both the day and night temperature decreases rapidly. January is generally the coldest month with the mean daily maximum temperature of about 22°c and the mean daily minimum about 8°c. During the cold season the minimum temperature may go down to about freezing point of water and frost may also occur when the district is also affected by the cold waves in the wake of the western disturbances.

The crucial air temperature is 6°c [5]. The air temperature at which active germination and growth begin to take place in winter is most useful for crops. The universal climatic elements of greatest significance to agriculture are temperature and moisture. Temperature conditions, express the amount of energy in the environment available for the conversion of minerals and moisture in to plant tissue [6]. For the agricultural geographer, the best indicators of regional differences in temperature currently available or easily derived are length of growing season and accumulated temperature above the minimum for plant growth [7]. In Etah the length of growing season and temperature, no where are the limiting factors to cropping. Throughout the year, it is favorable for crop-husbandry because the temperature is above the conventionally accepted threshold temperature.

CLIMATIC REGION:

The combined effect of the variations in the fundamental elements of weather (temperature, precipitation, atmospheric humidity, pressure and wind velocity) interplay between the various climatic controls many variations in climate exist, even within a small area or given latitude zone. The climatic studies have tended to become statistical analysis of the observations of individual elements. Because of this, climatology has been regarded in some quarterly as nothing more than statistical meteorology [8]. Climatic classification has

a number of advantages both to the geographer as well as to the scientist actively associated with other aspect of our natural environment such as soils, plants life, animal life and the configuration of land surface. By identifying climatic types we are able to predict various associated visible aspects of the environment. It may also enable the geographer to predict the climate of a region through his observation of the vegetation, animal life, soils or land forms [9].

In order to achieve a rational quantitative classification of climate of the district under study, definite and distinctive break points are discovered in the climatic series. No such break points exist in data either of precipitation or potential evapotranspiration. Both run in continuous series from very low values to very large ones. But when they are taken together, there are some distinctive points.

The climatic region of the Etah districts is based on the relationship between moisture and heat, and tries to know whether a climatic region is moist or dry and warm or cold and there is seasonal variation whether the climate is moist in one season and dry in another.

THE MOISTURE FACTOR:

Since it is not possible to know whether a climate is moist or dry by knowing the precipitation ~~for this~~ alone, it has been calculated whether the precipitation is greater or less than potential evapotranspiration. To know whether there is surplus or deficit of water in the region moisture index has been calculated. It is apparent that the actual evaporation and transpiration from the soil is not what must be compared with precipitation in order to obtain a moisture index, but, rather, the potential evapotranspiration. Where the precipitation is exactly the same as the potential evapotranspiration and water is available just as needed, there is neither water deficiency nor water

excess, and the climate is neither moist nor dry. Where water deficiency becomes larger with respect to potential evapotranspiration, the climate becomes arid; where the water surplus becomes larger, the climate becomes more humid (fig-1.7 surplus & deficiency of water).

The moisture index is calculated on the basis of following formula.

(Discussion needed!)

Moisture index (Im) = 100S – 60Q / PE

Where **S'** is the surplus of water

Q' is the deficit of water

PE' is the water need or potential evapotranspiration, which calculated on the basis of following formula. And adjusted through the table and nomogram [10]. ← not in list, Mention 'S'.

$$e = 1.6 (10t / I)^a$$

where **e** = monthly evapotranspiration.

t = mean monthly temperature in ^0c

I = summation of 12 monthly heat index$[(t/s)^{1.514}]$

a = further complex function of I

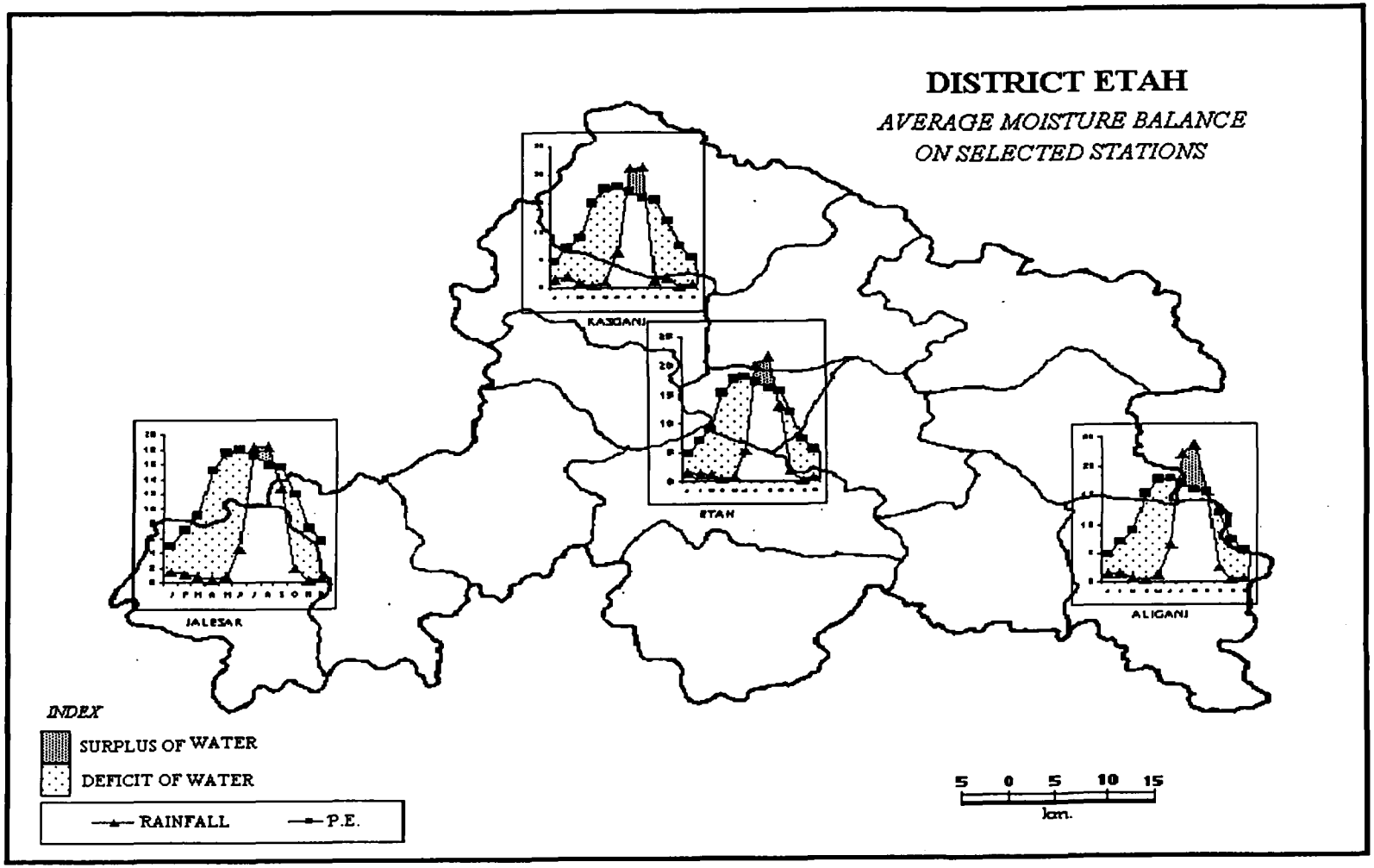
The whole of the district falls in the category of semi arid (d) type of climate. The precipitation data taken from all the four station (Etah, Kasganj, Aliganj and Jalesar) of the district shows a little variation owing to the plain topography and interior location of the district, consequently moisture index also shows a little variation.

Table-2.2

Moisture Index of the Selected Station	
Station	*Moisture index*
Etah	- 31.7
Kasganj	- 30.21
Jalesar	- 35.02
Aliganj	- 27.6

In figure-1.7, representative stations show the whole of the district has a moderate water surplus. There are two months (July and August), which have surplus of water. The summer concentration of the thermal efficiency in the district displays a mega thermal (a) type. We can say that summer concentration is of full mega thermal (a) climate. Table-1.3 shows, the water need, in the first column, is, of course potential evapotranspiration. column gives the percentage that summer potential evapotranspiration is of the annual total. The column labeled "surplus as percentage of need" gives the humidity index and that labeled "deficiency as percentage of need" the index of aridity.

The district have (DA'wa) is semi arid, megathermal with moderate summer water surplus and a temperature efficiency is normal to megathermal (Table 2.3).



Source- Calculated on the basis of Thonthwait's Formula

Fig-2.7

Table 2.3

Comparative Moisture data of selected Stations									
Station	*Water need*	*Summer need%*	*precipitation*	*Water surplus*	*Water def.*	*Surplus in %*	*Defficiency in %*	*Im*	*Climate*
Aliganj	57.6	40.7	31.15	7.7	34.1	13.3	59.2	-27.6	DA'wa
Etah	57.8	40.5	27.24	3.7	34.3	6.4	59.3	-31.7	DA'wa
Kasganj	57.7	40.7	28.70	5.2	34.2	9.0	59.2	-30.2	DA'wa
Jaleser	57.8	40.6	24.06	0..59	34.3	1.0	59.3	-35	DA'wa

NATURAL VEGETATION:

As the natural vegetation is the representation of the totality of climate of any region, the natural vegetation of the district Etah is dry deciduous type. There are two forest blocks in the district Etah, under the forest department namly senthri (65.5 hectare) and Sheetalpur (89 hectare). Land measuring 1013.96 hectare along the canal banks has been afforested 423 km. of road sides avenues have been planted.

Dhaka (Butea monosperma) trees are commonly seen in patches especially, in Azmnagarh,Pinjery,Daryaganj, Rampur, Arjunpur, Sidhpur, Utoma, Sikhra, Pachlana and Sirsa. *Babul* (Accacia arabica) is found most in *usar* land.

Under the scheme of road side avenues plantation program, *shisham* (Dalbergia sissoo),*Jamun* (Syzygium cimini),mango, *Kanji* (Pongamia pinnata) and Eucalyptus have been planted in recent years. The other common trees found in the district Etah are *neem*

(Azadirachta indica), *imili* (Tamarindus indica), *semal* (Salamalila malabarics), *gular* (Ficus glomirita). *bel* (Aegle moremelos), *ber(* Zizyphus jujuba), etc. the ornamental trees are generally found in the private gardens and on the canal banks are *kachnar* (Bauhinia variegata), *amaltas* (Cassia fistula), ashok, and *gulmohar* (Poniciana regia).

The long coarse grass called *gandar* is found along the Ganga and Burhganga river. The longer and stouter reeds, called *senta* used for making chicks and thatching are also found in the district. The *khas* (Zizamodes) grass is also found in the swampy ground. The *mum* (Saccharum munja) is commonly met within low lying areas and *patera* (Typha elephentina) is found in wet and water logged tracts. The other grasses found in the district are *dab* (Desmastachya bipinnata) and *siru* (Imperata cylindrica). The under growth is chiefly composed of *arusc* (Adhatod vasica), *hins* (Capparis zelanica), *karaunda* (Carrissa spinarum) and *makoya* (Ezyphus ocnapalia).

THE SOIL:

At the beginning of his work on political Geography, Ratzel made a far reaching statement "Jeder Staat ist ein Stück Menschheit" (every nation is a bit of soil an humanity) (Quoted by Jasbir Singh. 1976). Therefore no student of civilization forgets for an instant the fundamental importance of the soil. It is the source of practically al man's food, clothing and an ever increasing list of other needs. So much so that man gets nearly all of its food from the soil, less than one percent of what he eats being fish (Person and Horpes, 1945)[12]. Top soil or the upper layer having an average thickness of about 20 cm. in the principle feeding zone of the crops; provide food for human ingestion or livestock feeds [13].

Despite all the great advances in manufacturing, agriculture is still the world's most important primary industry – a fact often neglected, through appreciated in all historic, or economic crises. Such considerations apart, even now about 66 percent of the global population comprise farmers, deriving their living directly from the soil. Geographical investigation of soil characteristics in agricultural geography is of great significance as geography is human ecology 9 (Putman, 1967)[14] soil characteristics particularly physical, help to know about the distribution of crops and the section of the soil for specific crops: this may be called the selective rather than 'prohibitive' influence of the soil.

There is no resource more important to the district Etah than soil. Regardless of its production capabilities, and however carelessly mined, the soil as a medium of crop growth has furnished directly and indirectly a significant share of the income of the state. Therefore the soil resources must be used in such a way that they are conserved and not exploited; exploitation can mean soil destruction and depletion through the erosion and over-use. Soil exhaustion and depletion may increase rapidly in the near feature because of the demographic exploitation. The expansion of cultivation can be achieved by the agricultural colonization of the cultivable wasteland, which however is limited. Hence, the available soil resources need to be conserved and carefully used.

Differences in soil fertility, of course have the greatest impact on agricultural land use but after elements such as limited use of modern technical inputs, traditional settlement patterns and marked competition from the adjacent areas may also be relevant. The distribution of soils strongly affects the pattern of distinct land use intensity and agricultural land use occupancies owing to limited progress made in biological and mechanical form production

techniques, specially the restricted use of chemical fertilizers and hybridized seeds. However, where higher level of agricultural techniques has been achieved with intensification and mechanization, the modification of inherent soil characteristics have been accompanied by a diminution of soil fertility (Jasbirsingh, 1976).

SOIL CLASSIFICATION:

For the purpose of assessing and settling land revenue, the soils of the district were classified in the beginning of the present century. This classification has generally closely adhered to the traditional, local distinction of the soils and the same holds true even today. The most highly rated soil is the rich and well-manured belt immediately surrounding the village site, known as *gauhan.* In the western *Parganas* and second zone outside this called the *mangha,* is recognized. Elsewhere the *gauhan* was subdivided into two grades. For the outlying tracts the natural division into *matyar* or clay, *domat* or loam and *bhur* or sand, is adopted. There is a variety of rich loam found in the Ganga *Khadi* , the low lands of the Kalinadi and the Burhganga, generally known as *Terai.* The most valuable of the *Terai* soil is the rich, soft loam called by the name of the *Katra.*Being situated in the Gangetic *doab* the predominant soil in the district alluvium deposited by the Ganga and its tributaries. The parent material is, in general, calcareous and the native vegetation consists of the shrubs and low grasses. The soils are natural to moderately alkaline and calcareous, and have, sometimes, well developed by accumulation horizon in the subsoil.

In the *usar* and tracts affected by *reh* the characteristics feature of the soils in the presence of high content of soluble salts and or high percentage of exchangeable sodium. The calcium carbonate cemented pans are also a common feature of these soils.

Soil survey organization of the state agriculture department conducted a soil survey of the district in 1951-53, according to which the district is broadly devided into five physiographic soil regions, the Gana *Khadir,* the Ganga *Terai* the eastern upland, the southern low land and the western upland. Resulting from the influence of water sheds of the Kalnadi. The Ganga and its bed, the Burhganga and the topographical position of the above five regions, five soil association types have been identified which are given in the following table.

Table-1.4

TYPE OF THE SOIL IN THE DISTRICT ETAH

Soil Regions	*soil association types*	*Taxtural Name*
(1). Ganga Khadir,Gana Terai	Etah type.1	Ganga loamy soil
(2). Eastern uptands	„ „ 2	Etah loam
(3). Southern low lands	„ „ 3	Uayey loam
(4). Western low land	„ „ 4	Sandy loam
(5). a. Ganga Allunium	„ „ 5	Yamuna sandy loam
b. Yamuna Allinium		

Source- District Gazetteer 1990

The five soil associations (types) are described as below:

ETAH TYPE 1 (GANGA LOAMY SIDE):

The soils recognized as Etah type 1 occur in the tracts located mostly along with the river Ganga approaching Burhganga, which is an intermittent stream flowing in the old and abandoned beds of the

Ganga. The water table in the whole area is high except in places lying on comparatively high lands on the crest of the watersheds.

The soils in these areas are of a very recent origin and have been deposited by the Ganga while receding from south to north. The soils are very light and shallow overlying Pure Ganga sand. They are newly laid out alluviums and soil-forming factors have not yet been able to play their full part in stabilizing very definite horizons. The colour, in general is gray on the surface while lower layers tends to be lighter gray. Texture of the surface soils in general is loamy sand but becomes coarse sandy below. The PH values of these soils vary between slightly to mildly alkaline due to their comparative richness in bivalent cations. Salt efflorescence is noticed in depressed areas near the river where the water table is very high. The salts consist mostly of bicarbonates and chlorides and, unlike the *reh* deposits found further inland, are only very slightly alkaline. C-N ratio is about 7 on the surface, but decreases slightly with depths.

The water-soluble salts like high carbonates are found in the second and the third layers and also in terraces. Sulphates are conspicuous by their absence. The salts accumulation is, however, noticeable in small depressional pockets near the Burhganga due to a very high water table. The exchange status of these soils is low as expected as light textured soils, but the complex is highly saturated with bivalent cations.

ETAH TYPE 2 (ETAH LOAM):

The soils constituting this type are found to occupy the country between the old crest of the Ganga bank in the north and Kalinadi in the south, except for the immediate to neighborhood of soil boundaries and some other interspersed spots. High lying sandy belts also mark the crest of Kali. As the tract between the Ganga cliff and Kalinadi

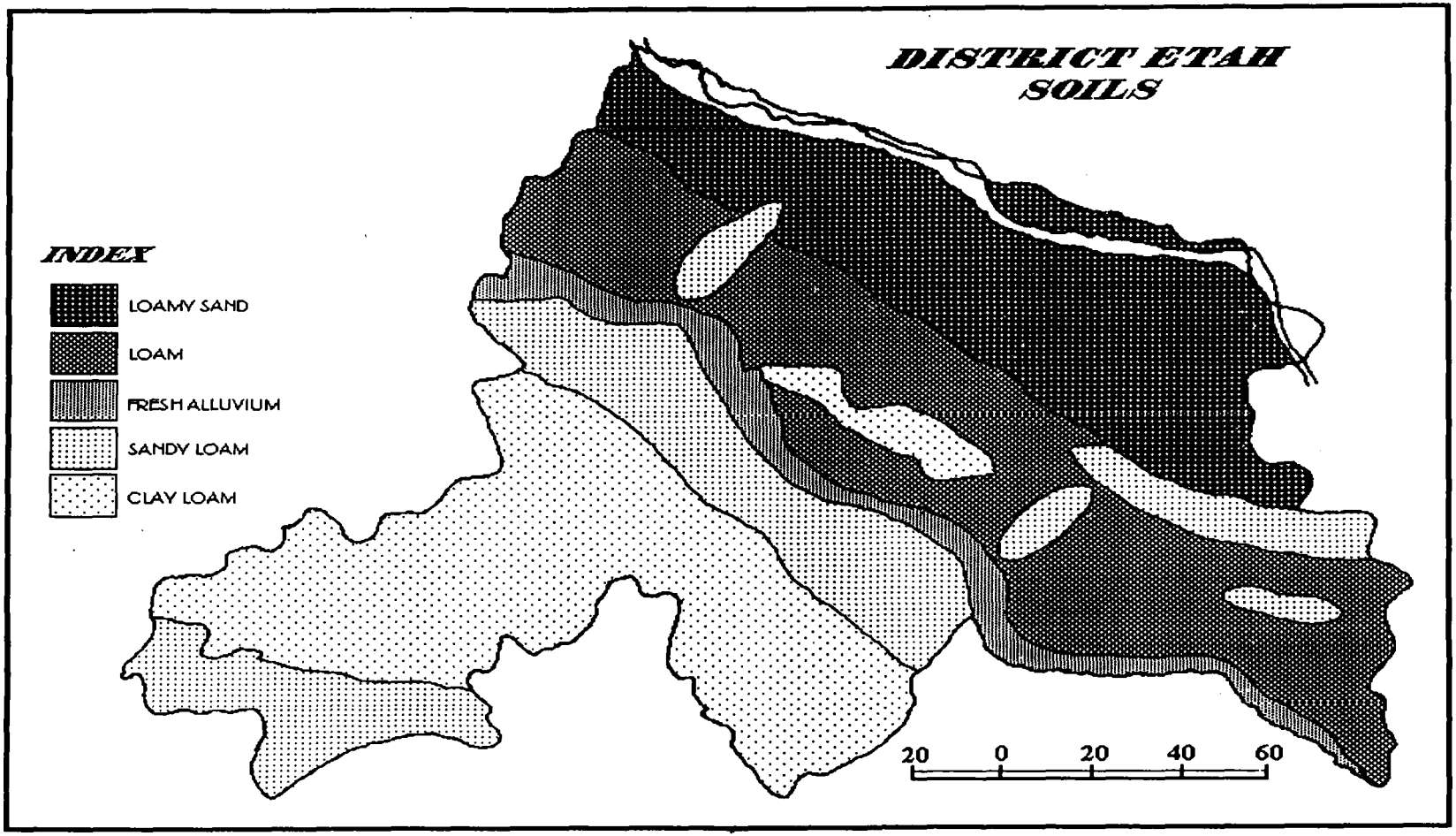
*/ It would be useful to add figures : texture, pH and chemical composition !

broadens out the soils improve in texture. In the north west where the tract is narrowest sandy soils predominate and even sand hill formations can be found; while in the south-east where the distance between the two rivers increases, soils with loamy texture predominate. Taken as a whole soils with loam texture with heavier sub soils dominate the area although lighter texture soils with sand deposits can also be found which seems to have been formed as a result of the deposit laid down by sand-borne winds from the two rivers.

The colour of these soils is mostly gray to brownish gray with occasional yellowish tinge in the lower layers. The soils are neutral in reaction except for interspersed depressional areas, not a few in numbers that contain alkaline soils. The soluble salts composed mostly of bicarbonates with some chlorides and sulphates are average to slightly light in the upper regions. Carbonates are absent except in low-lying areas where infestation with *reh* may be encountered. Total exchange capacity is comparatively high. Calcium accounts slightly more than 50 percent and the rest being accounted for by magnesium. Organic matter is low being only about 0.3 percent and is almost uniformly distributed. Total nitrogen is also more or less uniform, lying between 0.04 and 0.05 per cent except for the bottom layers where it may be slightly less. C-N ratio is in the neighborhood of 10 at the surface falling with the depth. The soils have moderate moisture retentive capacity, the value increasing gradually with the depth. Lime is slightly below 0.5 per cent but is uniformly distributed throughout the pedophile. Magnesium is throughout more than lime and shows displacement from surface to the lower layers.

ETAH TYPE 3 (ETAH CLAYEY LOAM):

The soils belonging to this type are ash gray to dark gray in color depending on the humification of the organic matter brought about in presence of different soluble salts. The soils are clayey loam in texture but at some elevated spots, even loam soils may be encountered and usually attain a cloddy structure. These become very compact and hard on drying and are then rendered difficult to plough. The soils are clayey in upper regions of the profile and the regions lying below may contain comparatively larger quantities of coarse sand. The soils are alkaline, the PH value in the normal cultivated soils being in the neighborhood of 8.5 per cent. The organic mater and total nitrogen contents are average but the C-N ratio is narrow, being of the order of six at the surface and still less in the lower horizons. Lime contents are maximum in layers below the fourth. Magnesia follows an increasing trend up to the fifth layer. It is more than lime in the upper three layers and less than lime in the regions of lime nodulations. The soils in general, are very ill drained but seem to be capable of improvement.



Source-District Department of Soil Survey

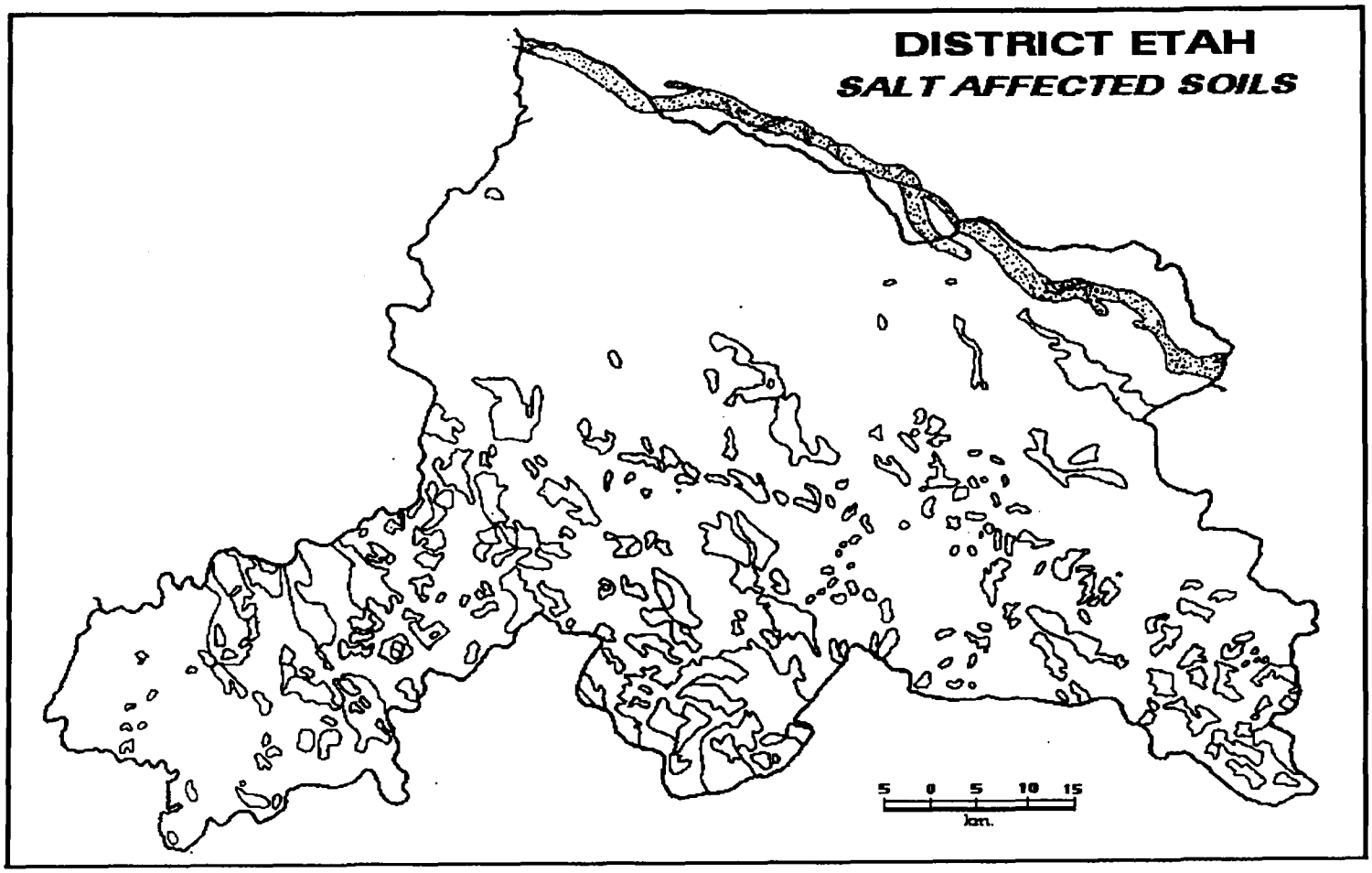
Fig-2.8

Table-2.5

THE BROAD DIFFERENTIAL CHARACTERISTICS OF THE ABOVE MENTIONED FIVE MAJOR SOIL TYPES ARE GIVEN IN THE FOLLOWING STATEMENT

Particulars/textural name	Etah type 1(Ganga loamy sand)	Etah type 2 (Etah loam) clayey loam)	Etah type 3 (Etah sandy loam)	Etah type 4 (Etah sandy loam)	Etah type 5 (Yamuna
profile development	Immature	Slightly mature	Mature	Mature	mature
Colour	Brownish grey to yellowish grey	Brownish grey to yellowish grey	Ash grey to grey brown	Brownish to redish	Light grey to grey
Texture	Sand to loamy sand	sandy loam to loam	Loam to cley loam	Sandy loam to sandy loam	Sandy to sandy
Concretions	Nil present	Brown nodules present	*Kankar* nodules lower layers	Brownish nodules in	Nil
Cemention	Not cemented	Weekly cemented Below	Indurated below	Not cemented	Subsoil compact
Consistency	Loose	Slightly hard below	Very hard	Loose	Loose
Sesquiodes	Low: irregular distribution	Average: slightly illuviated	Average very slightly illuviation	Average: marked illuviation	Low: Illuviation
Lome	Average to hogh Fused	Low: average below bottem	High: more towards	Low throughout	Average throughout
Magnesia	Average to high less than lime	Average: more then lime	High: more then lime in the upper	Average: more then lime throughout	Average: slightly more than lime
PH	Slightly alkaline	Low to slightly high	High	Medium	Medium to hogh
Clay	Low: negligible in Lower depths	Low to medium slightly illuviated	High: very slight displacement	Low: illuviated	Low: illuviated
Drainage	Imperfect	Fair: External drainage restricted	Impeded	Excessive	Slightly restricted

Source-District Gazetteer Etah 1990



Source-District Usar Land Development Ltd.

Fig-2.9

The salts consist mainly of carbonates and bicarbonates but also have substantial quantities of chlorides and sulphates of chlorides and sulphates which lend support to the belief that these soils are perhaps intermediary in the genetic development of a solonised phase from the normal zonal soil. The soils belonging to the saline-alkaline group of soils and the good patches only are suitable for cultivation.

ETAH TYPE 4 (ETAH SANDY LOAM):

It occurs comparatively on higher elevations, the strip parallel to and adjoining the Kalinadi and in the extreme southwest corner of the district in the Jalesar *tehsil.* The colour varies from brownish gray to brown tending to be reddish brown and the soils have a lighter texture. Although sand fractions in the profile are small, finer grained sand particles are as much as 83 per cent at the surface. In the lower depth, however, fine sand content decreases with consequent increase in clay contents. Silt also increases from 6.6 per cent at the surface to 29 per cent in the fourth layer after which the value declines again.

The drainage conditions of the soils are extremely good presenting a porous nature, and the water very rapidly drains out both laterally and vertically. The soils have a poor water holding capacity and are neutral at the top and slightly alkaline in lower layers indicating the downward movement of soluble alkaline salts. Organic matter is very low decreasing with depths, becoming almost negligible in the bottom layers. Nitrogen contents are also low, the value being as low as 0.02 per cent at the surface. C-N ratio gradually drops with the depth of the profile.

Lime contents are low, but the lower layers have better lime status than the surface. Magnesia is more than lime throughout. Carbonates and sulphates are practically absent and the entire

dissolved salts consist of bicarbonates and chlorides, the later being very low.

The soils are fertile but stand in great need of irrigation. Good *Rabi* and *Kharif* crops are obtained where irrigation facilities are available.

ETAH TYPE 5 (YAMUNA SANDY LOAM):

This type of soil occupies the area lying between the Isan and the western boundary of the district. The Isan in fact marks the center of Yamuna and Kalinadi doab and the former river influences areas of this river. The soils, in general, are of a light texture, stiffer and heavier in the subsoil. The well water in this area is brackish and is not suitable for irrigation. The soils are calcareous and consist of soluble salts. Calcareous concretions also found. The colour of the soils is light gray on the surface and gradually becomes darker in the lower depths. The surface soils are sandy in texture, coarse fractions being as much as 83 per cent, subsoil is of loamy nature and water retention capacity is poor. The soils of the entire profile are all along moderately alkaline. Both organic matter and nitrogen are inadequate and the C-N ratio is very narrow, the value ranging between 4 and 2. iron and aluminum oxide show similar trends. Lime contents are adequate throughout the profile and magnesia in general is slightly more than lime. Sulphates are almost absent.

The *tahsil*-wise distribution of these soil types is as under:

TAHSIL KASGANJ:

In the northern boundary of the *tahsil* along with the Ganga, there is a patch of fresh alluviums parallel to the river and there is a also a belt of loamy sand soil. The soils designated as Etah type 1 are sandy in nature formed by recently laid alluviums and comprise 20.25

per cent of the total land area of the *tahsil*. The rest of the land area of the *tahsil* is occupied by mostly Etah loam or Etah type 2 and comprises 70.75 per cent of the *tahsil* area. Some patches containing Etah clayey loam or Etah type 4 soils are also found in the middle of this tract and a patch of Etah sandy loam is found near Kasganj town. The soil type covers nearly 5.10 per cent of the total area of the *tahsil*.

TAHSIL ETAH:

The bulk of the soil found in Etah *tahsil* consists of Etah clayey loam or Etah type 3, which forms the entire southern boundary of the *tahsil* comprising about 70.80 per cent of the area. The soil northern portion of the *tahsil* beyond. Etah town contains Etah sandy loam or Etah type 4 soils and comprises about 20.25 per cent of the area. There is belt of fresh alluvium deposited near the northern boundary comprising 5.10 per cent area designated as Etah type 1 soil.

TAHSIL ALIGANJ:

Tahsil Aliganj is situated near the north-western boundary of the district and the pattern of soils is similar to that of Etah *tahsil*. In the northen portion of the *tahsil* along the Ganga, fresh alluvium is found in a belt. Below this belt, in the southern side, loamy sand soil is found. The Etah loamy sand or Etah type 1 soil is to be found in about 40 per cent of the total area of *tahsil*. Towards the south-west side there is a belt of Etah sandy loam or Etah type 4 soil covering not more than 10 per cent of the *tahsil* area. The rest of the *tahsil* is formed by Etah loam or Etah type 2 soils up to the boundary of Mainpuri district. There is an interzonal patch of Etah clayey loam or Etah type 4 towards north-west side of the *tahsil* near Aliganj town.

TAHSIL JALESAR:

Jaleasr is the southernmost *tahsil* of the district and is surrounded by Aligarh, Agra and Mainpuri districts. There are only tow types of soils found in the *tahsil.* About 50 per cent of the area in the northern part of the *tahsil* is covered by Etah clayey loam or Etah type3 soils. In the south of the *tahsil* there is Etah sandy loam or Etah type 5 forming about 50 per cent of the *tahsil* area.

In the alluvial tract of Uttar Pradesh, in which the district is situated, there are vast lands lying unsuitable for cultivation. There are saline, alkaline or *user* soils and there occur interspersed in between, loam, clay loam and sandy loam alluvial deposits. The soils form about 5 per cent of the total cultivated area of the district. Such soils are mostly found in Awagarh and Jalesar areas of the district though they are also found in Kasganj, Etah and Aliganj *tahsils.*

Refernce:

1. Krisna, M.S. (1960), Geology of India and Burma, p,-573
2. District Gazetteer,1980.
3. Singh Jasbir, (1976), An Agricultural Geography of Haryana, p-120.
4. Hildreth, A.C. et al., (1941), Effect of the Climatic Factors on Sowing Plants, United States Department of Agriculture, Year book, pp-292-307.
5. Schimper, A.F. Wilhem, (1903), Plant Geography upon a Physiological Basis. Oxford, Clarendon Press, pp 35-51
6. Watts,F.B. ,(1967), Climate, Vegetation, Soil in Canada: a geographical interpretation, p- 79.
7. Coppock, J.T. ,(1971), An Agricultural Geography of Great Britain, London, G.Bell, p-34.
8. Thornthwaite,C.W., (1948), An Approach towards a Rational Classification of Climate, Geographical Review, Vol. 38, p-55.
9. Lal, D.S., (1996), Climatology, Chaitanya Publishing House Allahbad, p-317.

Chapter-3

Cropping Pattern Before Introduciton of Green Revolution (since 1951)

CROPPING PATTERN BEFORE INTRODUCTION OF GREEN REVOLUTION

Cropping pattern means the proportion of area under various crops at a point of time [1]. A committee constituted by the Govt. of India in 1960 under the agriculture commissioner to determine the cropping patterns according to relative acreage of various crops in a district or a group of districts[2]. Before the induction of the green revolution, the farmers divided their cropping pattern broadly in relation to a set of traditionally accepted norms; the cropping pattern was ordinarily adopted in relation to individual fields. The adoption was determined partly by physical characteristics of the field but also purely locational factors were being next to the village dwelling where the problems of watch and ward had to be faced [3]. The overall deciding factors regarding the total cropping pattern of the cultivator's holding as whole and also included aspects as availability of manure and irrigation facilities and the need of the household for food and fodder.

The diversities in the type of soil and climatic conditions prevalent in different regions, have classified regions into agro-climatic regions. This is necessary but not adequate condition for developing a cropping pattern. Changes in cropping patterns need to be studied with reference to both physical and economic factor. This warrants a scientific attempt by the agricultural economist in collaboration with the agronomist and soil scientist to demarcate the major type of

farming region for developing a suitable cropping pattern rather than on administrative units.

Consideration of cropping patterns of a region should logically begin with the study of its climatic and soil condition that constitute the area and the subterranean environment of crop plants. This is particularly important in the case of small region like a district where these conditions exhibit a small diversity, which require a micro study. The distribution of crops, their production and the seasons of cropping are influenced by climatic factors such as temperature and rainfall, perhaps to a much greater degree than other environmental factors. Crops differ in their requirements of the optimum, maximum and minimum, temperature and react differently to change in the levels of this factor. Different crops have different moisture requirements too. Soil factors such as texture, structure, depth and topography, affect the moisture storage capacity of the soil and hence the choice of crops. Consequently, the suitability of crops for different areas is, to a large measure, controlled by climate inter-acting with soil; It is thus important to delineate the soil-climatic zone, not only to interpret cropping patterns as they exist but also to locate the maladjustment, if any and to project new cropping pattern in consideration of ecological factor.

Apart from soil and climatic conditions, the cropping pattern of a region will depend upon the nature and availability of irrigation facilities. Wherever water is available, not only a different crop can be grown, but even double or triple cropping will be possible. With introduction of first five-year plan, new irrigation facilities were provided; improved seeds and improved agricultural implements were distributed through the agriculture extension scheme (Table-3.1).

Table-3.1

AGRICULTURAL EXTENSION SCHEME 1951 -1960

	Years	195	1952	1953	1954	1955	1956	1957	1958	1959	1960
1	Improved seed distribution (mds)	16000	21410	26700	35500	50282	54452	59070	66472	80586	87050
2	Area sown with improved seed (acres)	27511	32200	33801	48613	69631	62197	72291	80752	38711	103285
3	Irrigation	369180	NA	3664422	365953	336590	292966	320810	325145	353570	307082
4	Number of improved agriculture Implements distribution types?	210	342	301	405	461	1066	935	263	961	574
5	No. agricultural demonstrations	1700	2205	2302	2446	5931	5603	4863	2059	1713	2166
6	Quantity of chemicals and other fertilizers distribution (mds)	2742	3463	6100	9333	14512	20680	66994	83041	73623	94962
7	Area under green manures	---	---	---	---	---	6073	6024	15162	15263	28113
8	Area under Japanese method of cultivation	---	---	---	---	44	660	1600	3565	8612	4375

Source-District Census hand Book-1960

Before the introduction of green revolution agricultural development has carried out through the agriculture extension schemes of five-year plan. Under the agricultural extension schemes, Area sown with improved seeds have shown a continuous increasing trend i.e. 27511 acre in 1951, 32200 acre in 1952, 33801 acre in 1953, 48613 acre in 1954, 69631 acre in 1955 and 103285 acre in 1961.

Same increasing trend have shown in development of irrigation facilities, agricultural implements and chemical fertilizers (table-3.1). The implementation of five year plan after the independence have made possible to grow a superior crop, a new rotation of crop where there was none, or a better rotation over what prevailed may be possible

In order to analyse the cropping pattern level in the district, it would be worthwhile to give some preliminary idea about the crops with sowing and harvesting seasons etc. As it is well known, that in India, there are two main seasons e.g. *Kharif* or the season of summer crops and the *Rabi* or the season of winter crops. The sowing in the *Kharif* season begins generally on the onset of the south west monsoon in mid-June, while the *Rabi* season starts at the beginning of cold weather e.g., at the end of October or early November when the monsoon is receded. The crops of *Kharif* season are *Bajra* (Pearl millets), Rice, *Jowor* (sorghum), maize, *Arher* (pigeon pea), *moong* (Green Gram), *urd* (Black Gram), groundnut, sugarcane, which require a high temperature and plentiful of supply of water. And the crops of *Rabi* season are: Wheat, barley, gram, *masoor* (lentil), peas and potato which require cool weather and moderate supply of water. The harvesting period of *Kharif* crops start at the end of monsoon e.g., September to October (may continue till November in some cases), and

the *Rabi* crops harvested from February to April (may continue till May in some cases), Table-3.2.

Table -3.2

SOWING AND HARVESTING SEASONS OF SELECTED CROPS

Name of crops	***Sowing***	***Harvesting***
Rice	Jun – August	Nov. – Dec.
Sorghum	Jun – July	Oct. – Dec.
Pearl Millet	Jun – August	Sep. – Nov.
Maize	Jun – July	August – Oct.
Wheat	Oct. – Dec.	March – May
Barley	Sept – Nov.	March – May
Gram	Sept. – Nov.	March – April
Pigeon pea	May – July	Dec. – July
Ground Nut	May – July	Dec. – January
Mustard	Jun – July	January – April
Sugarcane	Sept. – April	Oct. – Jun.
Potato	Sept. – Oct.	Nov. – Feb.

Source- Department of Agriculture District Etah.

IRRIGATION:

It is an unsuccessful attempt, to explain the spatial and temporal variation in the cropping pattern without ~~the~~ an enquiry about irrigation facilities of ~~/~~ the particular region. The advent of canals have bring

about revolution in the field of agriculture, while in the case of district Etah, every *Pergana* (Shire) receiving canal water except those in the Ganga, Burhganga *Tarai* where it is not needed. Besides canals irrigation has practiced from wells, tube wells and rivers. An unsatisfactory feature of the canals has been that in years of scanty rainfall, there is a short supply of water in them due to the low state of the Ganga.

Numerous streams and *nalahs* (Distributaries of Canals) existing in the district have been the source of irrigation since time immemorial through hand operated water lifting devices like *paira* (leather bag or bucket) , *dhakli* (pot and leaver apparatus), *rahat* (Persian wheel) and *dall* (basket made of bamboo or wide leather bag). The introduction of five-year plan promoted the development of irrigation facilities through the spread of canal distributaries.

Table-3.3

IRRIGATED AREA

1951-1966

(In Hectare)

Year	Irrigated area	Percentage of net cropped area
1951-52	156718.7	47.5
1955-56	158813	47.9
1960-61	167304.33	47.8
1965-66	169365	61.8

Source- District Gazetteer 1980

The above table shows that in the initial years after the 1950 i.e. first two-five year plan shows a slow growth in the acreage of irrigation e.g. 157618 hectare in 1950-51, 158813 hectare in 1955-56 and 157304 hectare in 1960-61. While after the 1960's it have jumped from 157304 hectare or 47.8% of net sown area in 1960-61 to 169365 hectare or 61.8 % of the net sown area (Table-3.3) before the introduction of green revolution the irrigation facilities have promoted through the five-year plan (Agriculture extension scheme). Since the 50's of the twenty-century the tube wells have given new scientific and more economic shape to the well irrigation system. Besides the govt. taking program of constructing sates tube wells, financial assistance to the cultivator have provided by the govt., the commercial banks, co-operative institutions and numerous

Table-3.4

AREA IRRIGATED BY DIFFERENT SOURCES

Years	Area irrigated from all kind of wells in (hectare)	Area irrigated from canals in (hectare)	Area irrigated from other sources in (hectare)
1950-51	68156.9	82935.2	5610
1955-56	75467.9	77214	6114
1960-61	92793.8	61883	2611.25
1965-66	105582	60954	2811.4

Source- District Gazetteer 1980

other quesi Govt. financial corporations. These Govt. efforts through irrigation facilities and other technical assistance have given a right direction to the cropping pattern which makes India self sufficient in ~~the availability of~~ food ~~production~~. In short, it was the beginning of the commercialization of Indian agriculture. Latter it was energize through the introduction of green revolution.

DISTRICT LEVEL CROPPING PATTERN:

Since this study have selected main crops of the district, therefore, it is worthwhile to examine their relative position with respect to area of each of them in the district. The crops selected are rice, wheat, barley, sorghum, pearl millet, maize, gram, pulses (including, *moong, arher,* peas etc.), oil seeds (including groundnut, rape-seeds and mustard), sugar cane and potato. Table-3.5 shows ~~a~~ trend of progress ~~of~~ each crop in respect of area during 1951, 1955,1960 and 1965 in the district. It is clear from the table-3.5, that there exists a little possibility for extending areas horizontally under the crops as the situation has already reached a saturation point. As a result, the only measure to raise the area under particular crop is the reclamation of barren or *usar* land. It can be justified from the table-A which shows a little variation in total area devoted under the crops. Among the individual crops rice, pearl millet, maize, wheat, oilseeds and sugarcane show an increasing trend (since 1950-51) in area devoted to them. Pearl millet is the only crop, which attained an abrupt shift from about 65928 hectares in 1950-51 to 82559 hectare in 1955-56 and about 80575 hectare in 1960-61.

Table-3.5

AREA OF CROPS IN DISTRICT ETAH – A TREND OF PROGRESS

(in hectare)

Name of crops	1950-51	1955-56	1960-61	1965-66
Food crops				
Paddy	11170	16475	17524	18432
Wheat	86240	87231	88455	92308
Barley	39621	36329	29580	29320
Sorghum	15121	12324	8716	7520
Pearl Millet	82559	81230	80575	81530
Maize	26552	33528	42000	45320
Gram	32979	38223	48857	48730
Potato	2485	3025	3466	3867
Other food crops	5498	58630	62266	66259
Total food crops	302225	366995	373345	
Non food crops				
Sugarcane	11175	13559	14234	1523
Oil seed	2399	7694	16522	18422
Cotton	9614	1664	1659	1203
Fodder	11349	7944	7847	6327
Other non food-crops	3026	2610	2099	2001
Total non food crops	37563	35255	42361	43183

Source-District Census Hand Book, 1951, 1961 and 1971

This shift may be accounted ~~due~~ to the successful implementation of five-year plan in the district during the period 1950-51 to 1955-56 and 1955-56 to 1960-61; Rice records second place in the area and changes their being about 5721 hectare in 1950-51 to 11170 hectare during about 1955-56 and about 17524 hectare in 1960-61. Maize accounted for an increase in area next to the rice: 28175 hectares in 1950-51 and 42000 hectares in 1960-61. In case of oilseed and sugarcane the increase seems in a gradual order, but oilseeds represents a sharp increase of about 2359 hectare in 1950-51 to 16522 in 1960-61 and 18422 in 1965-66.

P.S.: hectares can be abbreviated to - ha

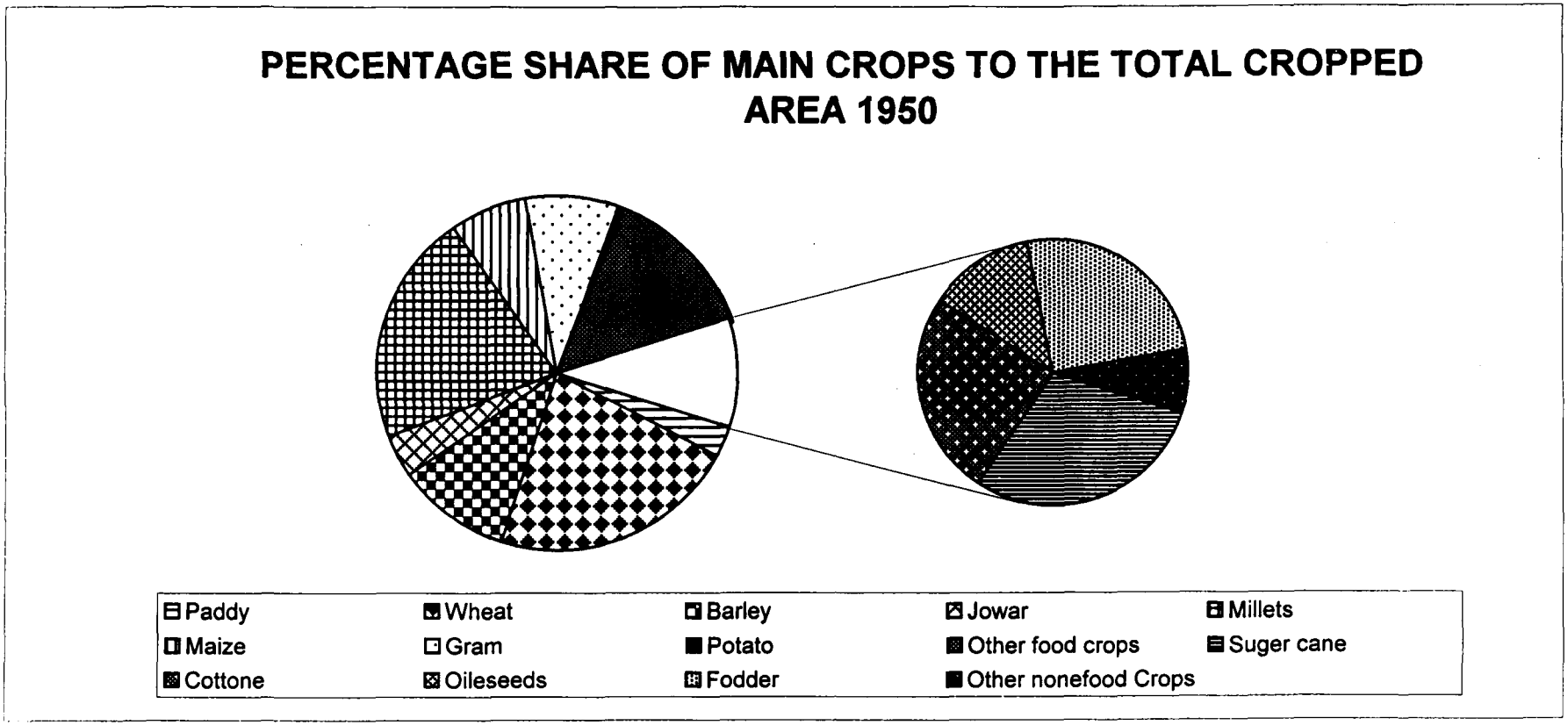
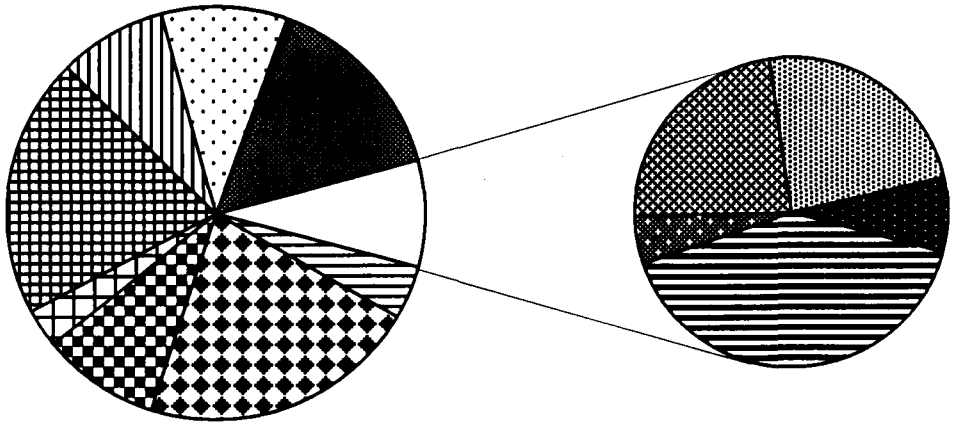

PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA 1950
Paddy
Wheat
Barley
Jowar
Millets
Maize
Gram
Potato
Other food crops
Suger cane
Cottone
Oileseeds
Fodder
Other nonefood Crops

Fig. 3.1

PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA 1955



Paddy	Wheat	Barley	Jowar	Millets
Maize	Gram	Potato	Other food crops	Suger cane
Cottone	Oileseeds	Fodder	Other nonefood Crops	

Fig. 3.2

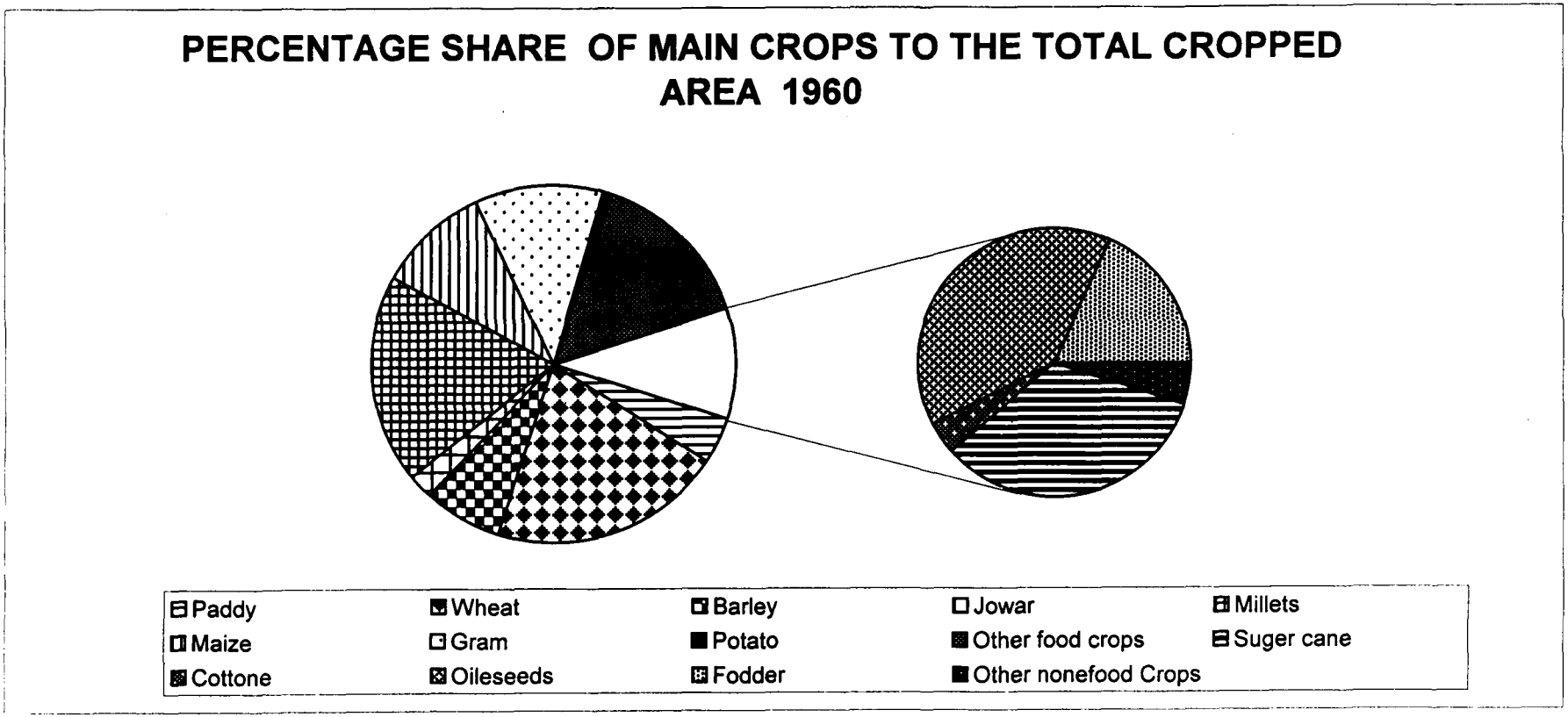

PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA 1960
Paddy
Wheat
Barley
Jowar
Millets
Maize
Gram
Potato
Other food crops
Suger cane
Cottone
Oileseeds
Fodder
Other nonefood Crops

Fig. 3.3

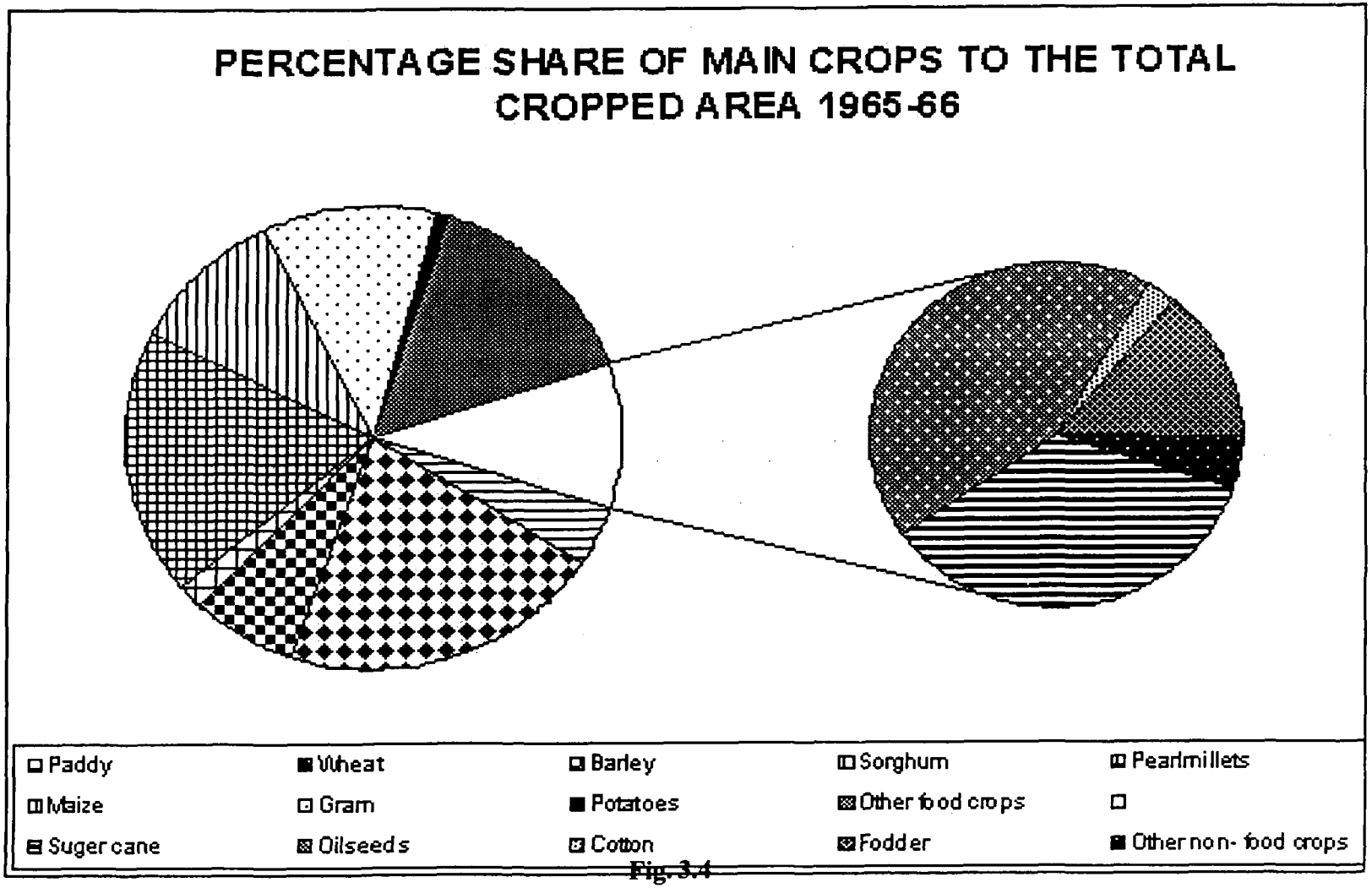

PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA 1965-66
Paddy
Wheat
Barley
Sorghum
Pearlmillets
Maize
Gram
Potatoes
Other food crops
Suger cane
Oilseeds
Cotton
Fodder
Other non- food crops

Fig. 3.4

RATE OF GROWTH IN THE AREA OF FOOD CROPS:

~~Further~~ Extensions in area under the crops consider~~ation~~ in the district are rather limited. The crop data (food crop) for the district shows a growth rate between the periods 1950-51 and 1955-56 as only 1.53 per cent and between 1955-56 1960-61 as 0.19 per cent per annum, while the area under non food crops shows a decreasing trend during the period 1950-51 and 1955-56 as 1.05 per cent per annum. Though, during the period 1955-56 to 1960-61 the area under the non food crops shows increasing trend with 4.4 per cent per annum.

It would be clear from the table-3.5 that all crops with exception of the few crops experienced extension in cultivable area before 1960-61. From the crop wise details of growth rate, it is evident that there are a few crops which show a decrease in acreage e.g. barley 1.66 per cent per annum, *Jowar* 3.7 per cent, millets 0.32 per cent and fodder 3.66 percent per annum decrease in acreage during the period of first five year plan e.g. 1950-51 to 1955-56. In all the food crops, paddy shows a highest growth in acreage per annum e.g. 9.4 per cent per annum and the lowest growth rate was noticed in the wheat acreage e.g. 0.23 per cent per annum. The other food crops, maize, gram and potato recorded a growth rate 5.25 percent, 3.18 per cent and 4.34 per cent per annum respectively.

During the period of 1950-51 to 1955-56, the areas under non-food crops have increased too, with a few exceptions e.g. fodder. The acreage under fodder crop decreases at the rate of 3.66 per cent per annum, during the period of 1950-51 to1955-56. The sugarcane and oil seeds crop recorded an increase at he rate of 4.2 per cent and 10.9 per cent increase per annum in the district *Etah* during the same period.The figure of growth rate during 1955-56 and 1960-61 shows a

slow rate in companion to 1950-51 to 1955-56 in the area under various crops. Two crops, gram and maize recorded highest growth rate per annum e.g. 5.56 per cent and 5.05 per cent per annum respectively while the other crops, paddy, wheat and potato recorded a growth rate between 0.2 to 2.91 per cent per annum. The acreage under some crops noticed a decreased at the rate of 5.85 percent per annum under *jowar,* 3.71 per cent per annum under barley and 0.16 per cent per annum under millets during the period of 1955-60.Oil seeds recorded an unparalleled growth rate e.g. 22.94 per cent per annum during the same period.

The percentage share of various crops to the total cropped area for 1950-1955 and 1960 can be observed in fig. 1, 2 and 3. Analysis of percentage share of various crops to the total cropped area clearly indicates that the wheat have the largest share to the total cropped area e.g. 22.15 per cent in 1950-1951-21.21 percent in 1955-56 and 20.87 percent during the period of 1955-1960. The second most important crop of the district is millets, which was sown on 21.2 per cent of the total cropped area in 1950-51, 19.75 per cent in 1955-56 and 19.01 per cent in 1960-61. The analysis of the figure shows that about 90% of the total cropped area used for the cultivation of food crops and only 10 per cent is in used for the non-food crops. The most important non- food crops of the district are, sugarcane and oil seeds, which have around 3.4 per cent, share to the total cropped area of the district.

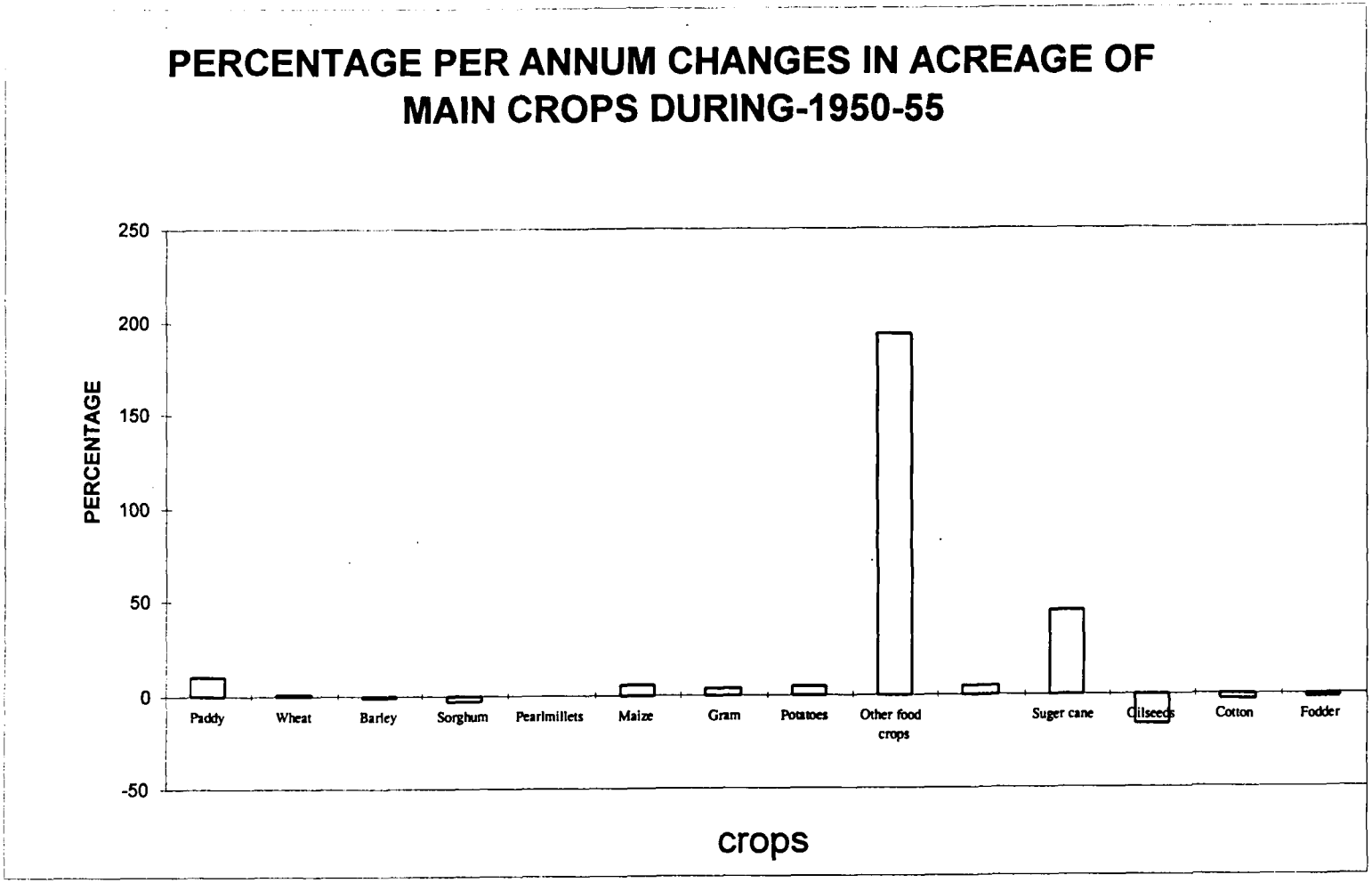

PERCENTAGE PER ANNUM CHANGES IN ACREAGE OF MAIN CROPS DURING-1950-55
250
200
150
100
50
0
-50
PERCENTAGE
Paddy
Wheat
Barley
Sorghum
Pearlmillets
Maize
Gram
Potatoes
Other food crops
Suger cane
Oilseeds
Cotton
Fodder
crops

Fig-3.5

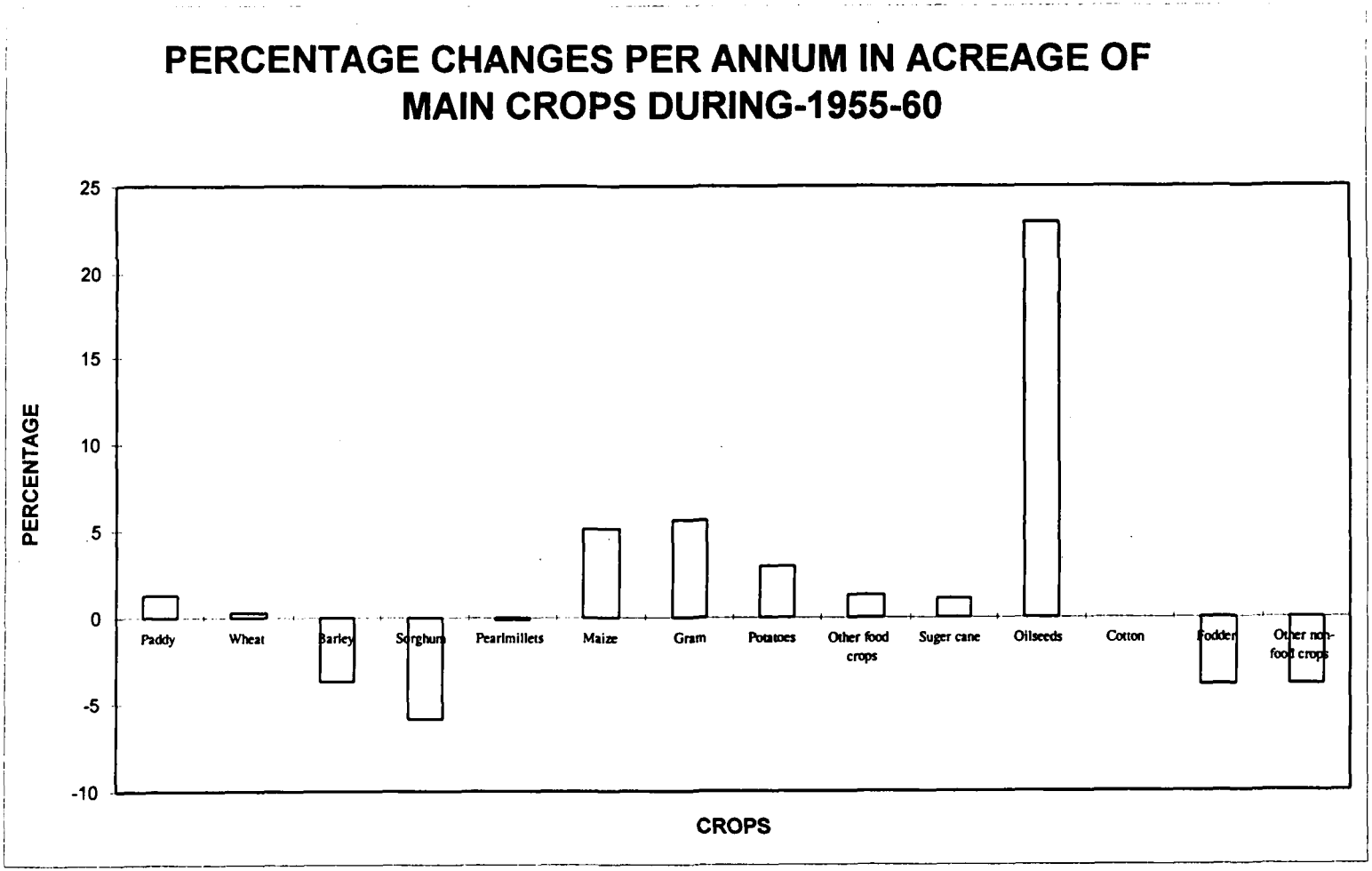

PERCENTAGE CHANGES PER ANNUM IN ACREAGE OF MAIN CROPS DURING-1955-60
PERCENTAGE
25
20
15
10
5
0
-5
-10
Paddy
Wheat
Barley
Sorghum
Pearlmillets
Maize
Gram
Potatoes
Other food crops
Suger cane
Oilseeds
Cotton
Fodder
Other non-food crops
CROPS

Fig-3.6

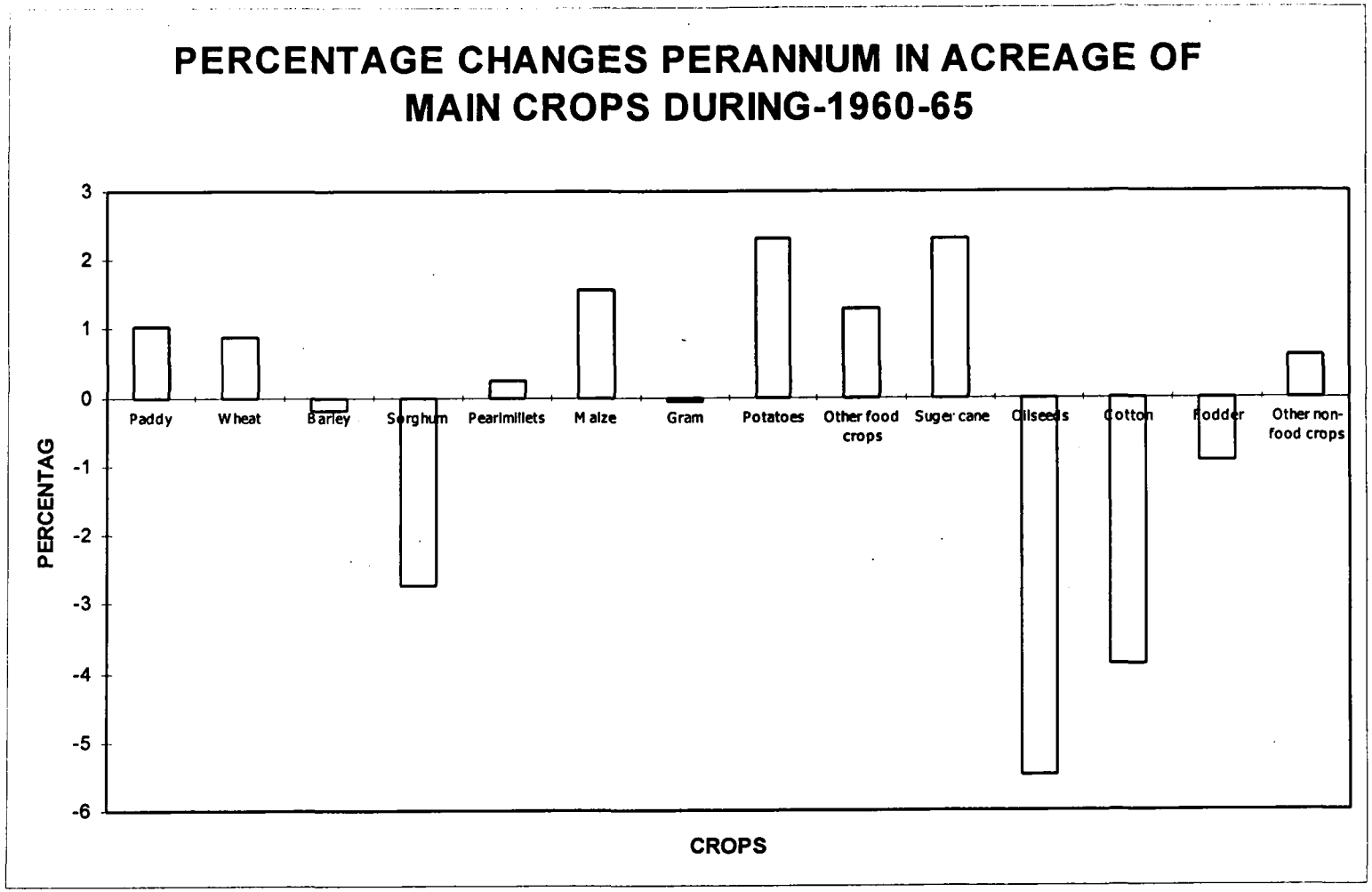

PERCENTAGE CHANGES PERANNUM IN ACREAGE OF MAIN CROPS DURING-1960-65
3
2
1
0
-1
-2
-3
-4
-5
-6
PERCENTAG
Paddy
Wheat
Barley
Sorghum
Pearlmillets
Maize
Gram
Potatoes
Other food crops
Sugercane
Oilseeds
Cotton
Fodder
Other non-food crops
CROPS

Fig-3.7

The over all analysis of the cropping pattern of the district *Etah* before the introduction of the green revolution, during the period of 1950 to 1960 shows that the more emphasis was given on the food crops. With the introduction of economic planning in 1950-51 and with the special emphasis on agricultural development, the previous trend of stagnant agriculture was reversed. There was steady increase in area under cultivation and yield, as a result of the increase in area as well as increase in yield per hectare total production of all crops recorded a rising trend.

Reference:

1. Kanwar,J.S., (1968) *'Cropping Patterns, Scope and concept'* Proceedings of the symposium on cropping pattern in India' ICAR, p-13
2. Agricultural Situation, (1964), pp-435-471.
3. District Census Hand book, 1951, 1961 and 1971.

Chapter-4

Changing Pattern of Crops After the Introduction of Green Revolution (1975-2000)

CHANGING PATTERN OF CROPS AFTER THE INTRODUCTION OF GREEN REVOLUTION

The study of cropping pattern involves the description of area under various crops and changes therein during a certain period of time which gives a clue to understand the option preferred by farmers. The cropping pattern varies from region-to-region in the area in space and time due to interplay of physico-cultural and technological factors. Appendix presents the percentage area under some important crops. It reveals that wheat predominates over all other crops and the magnitude of area of wheat has increased. In 1995-96 it covered 35.4 percent while 1999-2000 it registered about 36.58 percent. It is significant to note that area under sugar cane is constantly decreasing and it registered a rate of 7.89 percent during the period of 1975-80. In 1975 it covered an area of about 22200 hectare and in 1999-2000 it decreased about 12882 hectare. The area under potato has also increased to about 180 per cent and the area under paddy has also rose to about 65.16 percent the area under maize grew up to 6.42 percent in 1975-76 and in 1999-2000 reached to 11.35 percent. This result amply suggests that cropping pattern is changing in the district, and shift from cereal to cash crops potato and high yielding varieties of cereals such as wheat and paddy. These variations have their genesis in the human choice to grow the crops for monetary gain and the facilities easily available to the farmers. The block wise analysis of the cropping pattern indicates that the area under different crops also exhibits almost the same patterns with few exceptions. The percentage

of area under rice cultivation in most of the block cropping pattern generally reveals the spatial adjustment of crops among themselves in a given point of time according to prevailing conditions. Change in cropping pattern is a significant feature in the agriculture landscape of a region. The region lying between the two great rivers of India the Ganga and the Yamuna is one of the most fertile and densely populated part of the state Utter Pradesh where about 80% of the cultivated land is occupied by grain crops which are largely grown for domestic consumption[1]. The District Etah under study is a part of the Ganga-Yamuna *doab*. This region (Ganga-Yamuna *doab*) enjoys the highest level of agricultural efficiency in the whole of Utter Pradesh[2]. Eath has evolved its own cropping pattern practice depending upon the suitability of soil, climate of the region and food habit of its population, the alluvial type of soil and adequate irrigation facilities. Nearly 75 percent of the cultivated land is devoted to the grain crops and rest 25 percent covered by other crops i.e. cash and non-cereal both.

The main objective of the research is to systematize and improved understandings of the change induce in the pattern of crops land use. The focus of interest broadly involves a dual effort just defining the basic geography of change and its behavior in terms of rates of acceleration and deceleration, and secondly, a search for the types of factors that have set the discoursed changes in motion. In a very real sense of course, individual crops in any agricultural area in a state is of essential competition one with another for the favours of the farmer and for a place on his land.

EXPANSION OF CULTIVATION:

Land use is perhaps the most basic concept of agricultural economy. It is the key to an understanding of geographic adjustment of the agricultural resources. Moreover, regional land use patterns are,

after all the geographical expression of a large number of societal decisions made at different times for often very different reasons, which are responsible for the expansion of one category of land use at the cost of other. The introduction of Green Revolution has reached its limit to the expansion of cultivated land. The district Etah reached almost the physical frontiers in matter of expansion of area under cultivation during the period 1970 to 1999 when the cultivated area increased from 70.01 per cent to 80.85 per cent. Thereafter, the increase in cultivated area is insignificant as data (Appendix-1) high lights the facts, that we can not look to more lands to meet the increasing demands of food in the future, as over major spread of the district the proportion of cultivated area is over 85 per cent. This percentage strength that is very high, when compared with the state average of about 68.96 per cent. Within the district, there are no wide differences from one region to another in the cultivated area, because district Etah is one of the most cultivated districts of U.P. The face of the district have described as a carpet of tillage fields. High proportions of cultivated area (over 70 percent) cover a major spread of the district Etah as against lower one (under 70 per cent) covering only the *tarai* tract and salt affected (user land) stretches in the south and South –West block of the district. The high proportion owe to first, the alluvium sandy loam and loamy sand agricultural lands Second, easily workable alluviums having excellent irrigation facilities in the old and newly irrigated areas.

HARVESTED CROPLAND:

The extension of cultivation is not a matter of significance at present, except for achieving local gains. Intensity of cropping, extent of maturity and increase of the yield from the existing cultivated area are problems of paramount importance in the agricultural economy of India. It would be useful to overcome these problems in the

foreseeable future to analyses the changes in the cropping pattern. Hence, it is imperative to investigate the degree of efficiency with which the net area sown is utilized.

Table-4.1

CROPPING INTENSITY IN DISTRICT ETAH

Development Block	1975-76	1999-2000
Marehra	172.65	180.8
Nidhauli Kalan	148.31	167.9
Sheetal pur	156.71	178.74
Sakeet	145.18	155.44
Sahawar	145.61	218.69
Sirpura	148.87	179.40
Kasganj	186.106	183.74
Amanpur	168.93	206.59
Soron	153.67	199.18
Aliganj	133.92	160.56
Ganj Dundwara	116.31	139.31
Jaithra	143.34	169.75
Patiali	121.99	157.8
Jaleasr	149.07	148.28
Awagarh	140.31	167.96

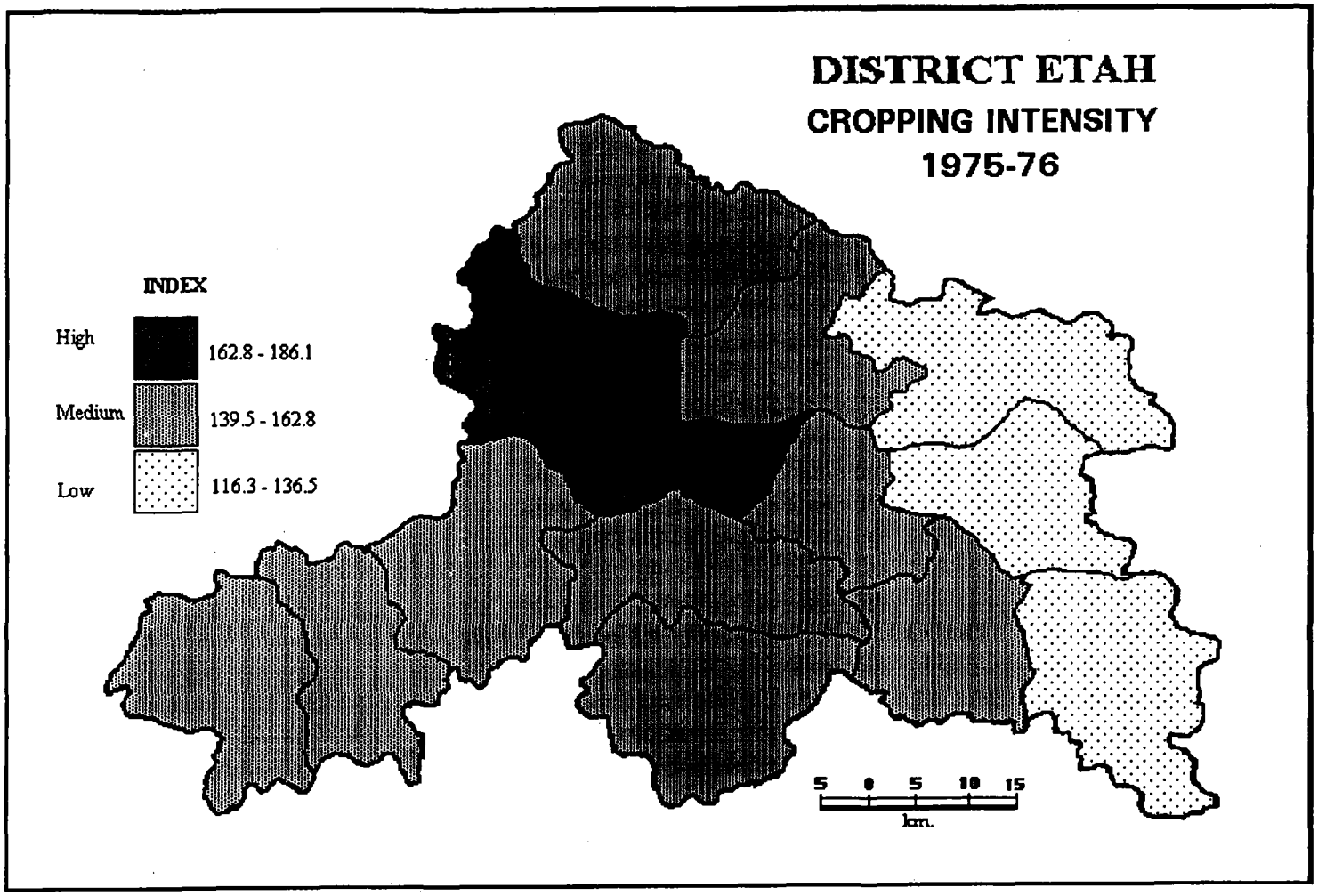

DISTRICT ETAH
CROPPING INTENSITY
1975-76
INDEX
High
162.8 - 186.1
Medium
139.5 - 162.8
Low
116.3 - 136.5
5 0 5 10 15
km.

Fig -4.1

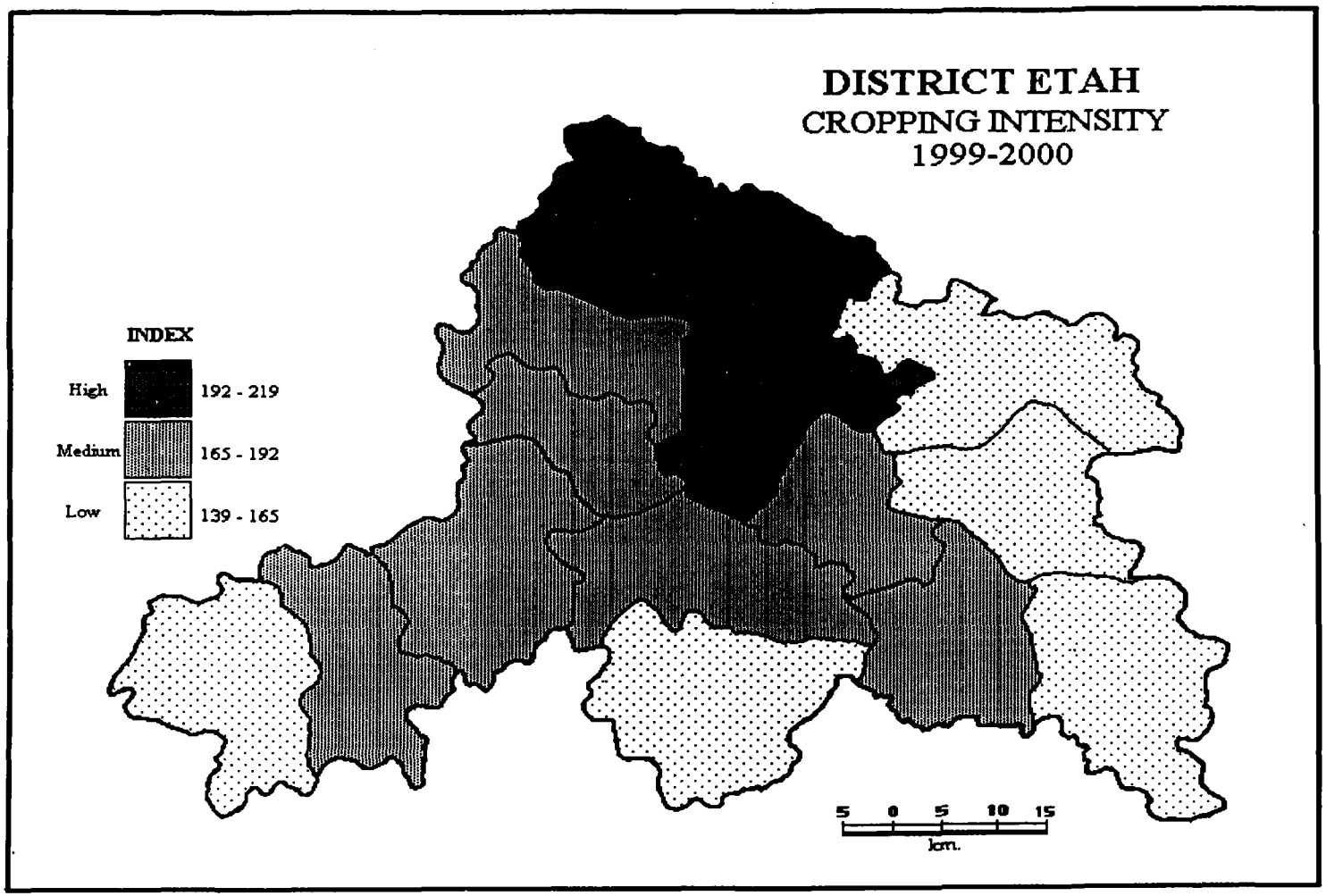

DISTRICT ETAH
CROPPING INTENSITY
1999-2000
INDEX
High
192 - 219
Medium
165 - 192
Low
139 - 165
5 0 5 10 15
km.

Fig. – 4.

Cropping intensity means the land use efficiency, is definable as the degree to which the net area sown is cropped or resown. The total cropped area as a percentage of the net area sown gives a measure of land use efficiency, which really means the intensity of cropping. The intensity of cropping refers to the number of crops raised on a field during an agricultural year. For example: if one crop is grown on a field either as a *Kharif* or as a *Rabi* crop in a year, the index of cropping is 100 per cent and it can be farmed as single cropping. If two crops in a year are procured as *Kharif* and *Rabi* crops, the intensity index will be 200 per cent and such case can be designated as double cropping; if three crops in a year are produced as *Kharif, Rabi* and *Zaid rabi* the intensity of cropping will be 300 per cent and it will be a case of multiple cropping. Therefore, higher the index of cropping intensity higher is the land use efficiency and vise-versa. In densely populated country intensification proceeds mechanization but converse is the case in the context of district Etah. Although district Etah is a part of Ganga plane the geography of its agriculture is exceedingly complex. It is accentuated by the impact of continued irrigation development and state intervention in agriculture. The years between 1975 and 2000 witnessed major changes in the agricultural land use in India in general, Etah in particular because of the expansion of irrigation facilities and launching new agricultural strategy. The extension of irrigation from canals and tube-wells along-with adoption of modern form of technology by the assiduous receptive farming commodities improved the agricultural progress. Still there are 'poor areas' in the agricultural economy of the district Etah where the magnitude of land use efficiency or intensity of cropping is 139 percent, as in these sectors only less than 39 per cent of the net area sown is recropped during an agricultural year.

In district Etah, the land with assured irrigation facilities and good quality of soil can bear two or three crops in a year, provided the fields are

carefully cultured. Extent of crops sown in an area in any agricultural year is more than the net area sown. A successful season of monsoon is the controlling factor for the intensity of cropping in the region under study, but in rain fed areas particularly. The most district explanations of the variation in the aerial distribution of cropping intensity index have of course, reference to the effect of irrigation intensity, cultivator's density, the nature of soil, the rainfall characteristic and the size of operational holdings. All over the district Etah, the total cropped area exceeds the net area sown because there always is a part of later. Which sown during both the crop season. The cropping intensity index in the district varies from 139 to over 218 per cent exhibiting a great regional disparity (Table 4.1).

Three categories have been identified in figure-4.2 and for the purpose of discussion these have been grouped into three regions comprising the areas of low intensity indexes (under 165 percent), areas of medium intensity index (165 to 192 percent) and areas of high to very high intensity index (above 192 percent). Areas of low intensity indexes are those that have poor irrigation facilities, limited surface water, decreasing water table salt ridden water (in Jaleser and Skeet) influents and water pouring due to poor drainage system impose restrictions on the extension of double as well triple cropped areas. It is quite obvious that a *second Rabi crop in the same field cannot fallow a kharif crop* if there is a soil moisture deficit. On the other hand, moisture is excessive as may happen in the *Katery* area; the soil might suffer, making it difficult to plough the field for *rabi* crops. The area of low intensity is Patiali, Aliganj and Sakeet where two factors play major role, i.e. salinity of the soil (*usar land*) and the development of *Katery* (due to pouring of water). The areas of high and very high indexes are confined to the development blocks which have tube-well irrigated fertile soil and availability of mechanical appliance, e.g. Sahawar, Amanpur and Soron. The development of improved soil drainage

and the availability of mechanical power have enabled much of the heavy level to be more intensively cultivated. On the whole, high and very high intensities are observed in areas having fertile loamy soils developed irrigational facilities or favourable rainfall. Elsewhere, the intensity index is moderate because of restrictions imposed on cropping by the fluctuation in the supply of agricultural water.

The changes in the extent of the double-cropped area are mainly because of expansion of canal and tube-well irrigation and the exceptionally high growth of rural population and process of settlement. Besides these two vital influents, the growing of cash crops the degree of workability and fecundity of the soil, the size of operational holdings and the initiative of the peasant are some other factors in determining the changes. The discernible annual fluctuation in the double-cropped area is due to annual variation in the amount and distribution of rainfall and canal discharges the long-term changes are associated with the changes in the intensity of irrigation, the agricultural population and form technology over the same period. A comparison of figure 4.1 And 4.2, highlights the outstanding changes in the intensity of cropping during the period under review.

TREND IN CROPPING PATTERN:

Wheat is the most important cereal consumed by millions all over the world. It is the premier crop of the state and the staple food of the people living in the whole western U.P. The Etah district produces 2.45 per cent of the state total quantity of wheat and 2.25 Per cent of the total cultivated area of the state lies under wheat in the district Etah. All the development blocks of the district are provided with the best type of soils for the growth of this crop. Wheat is the first ranking crop of all the blocks in the area under study. In the block of Nidhauli Kalan wheat occupied 39.134 per cent of the gross cropped area of the block or 11842 hectare

during the period of 1975-76. Wheat becomes a crop of first rank during the same period. During the period of 1980-81 the total cultivated area under wheat increased from 11842 hectare in 1975-76 to 12306 hectare in the 1980-81 and 13586 hectare in 1990-91. The area under wheat has increased due to the reclamation of cultivated land. Data indicate that wheat have remains first position in the block. Again the cultivated area of wheat in the block of Nidhauli Kalan increased during the period of 1999-2000. This year wheat covered 41.26 percent to the gross cropped area of the block or 15002 hectare (Appendix-1). It maintains its first rank in the block throughout the period under study. The increased in the cultivated area of wheat may be ascribed to adequate irrigation facilities, reclamation of cultivated land and demand as a staple food crop of the area.

The development block of Jaithra have a first rank in the wheat acreage and covered 33.87 percent to the gross cropped area of the block or 11475 hectare in 1975-76. During the period of 1980-81 the cultivated area of wheat increased in the development block of Jaithara from 11475 hectare in 1975-76 to 11926 in 1980-81 and 13553 hectare in 1985-86; 14308 hectare in 1990-91; 15786 in 1995-96 and 16316 in 1999-2000. The development block has recorded the highest five yearly growth in 1985-90 during the period under study it was 13.64 percent (Appendix-1). This tremendous increase in the area under wheat cultivation is ascribed to the diffusion of innovation and the application of highly mechanized agricultural appliance.

In the district Etah, the development block of Soron has the highest its cultivated area under wheat cultivation i.e. 17404 hectare or 35.61 percent to the gross sown area in 1999-2000. The development block of Soron have 8.93 percent acreage under wheat cultivation of the total wheat acreage of the area under study.

PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

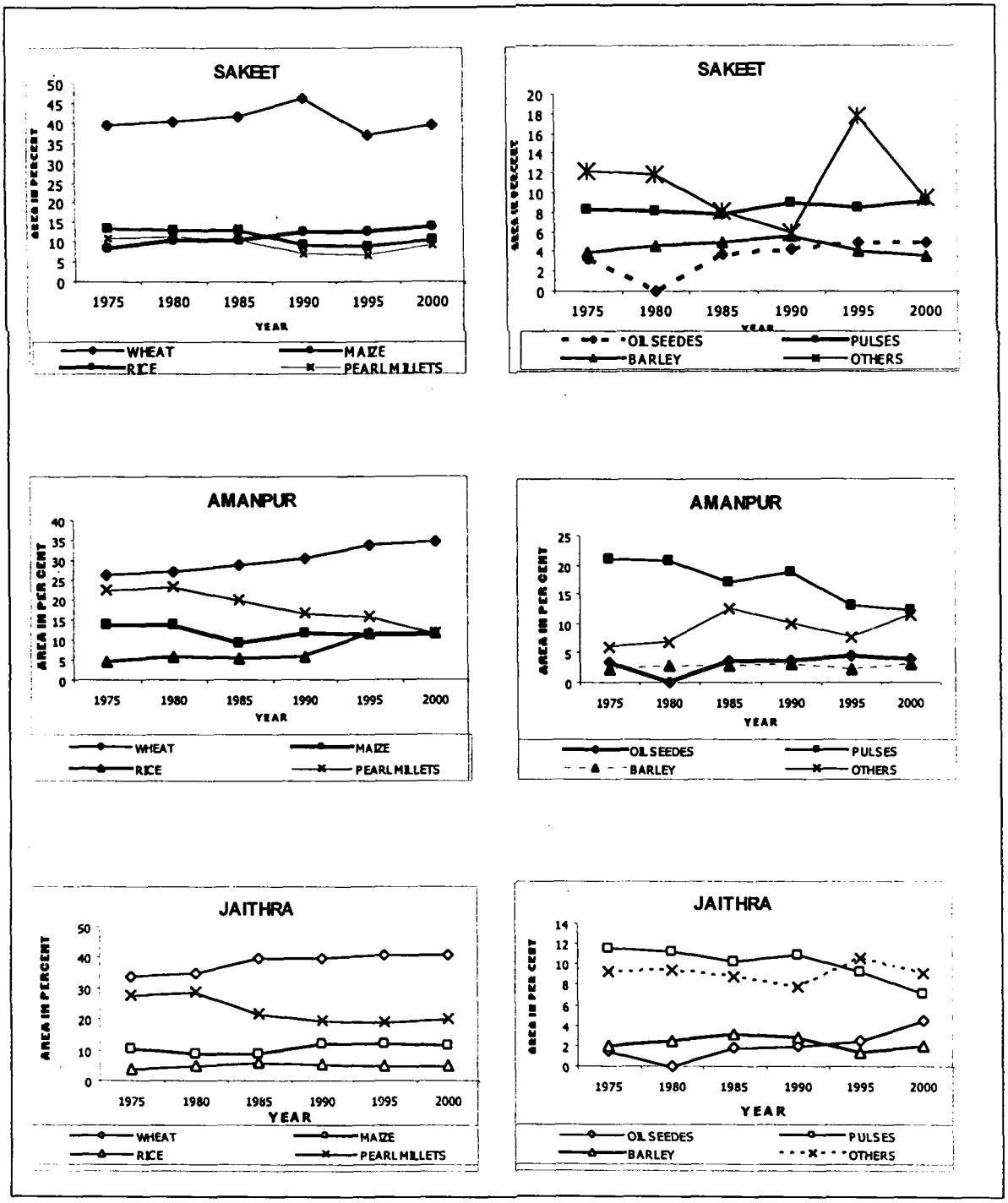


Fig -4.3

PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

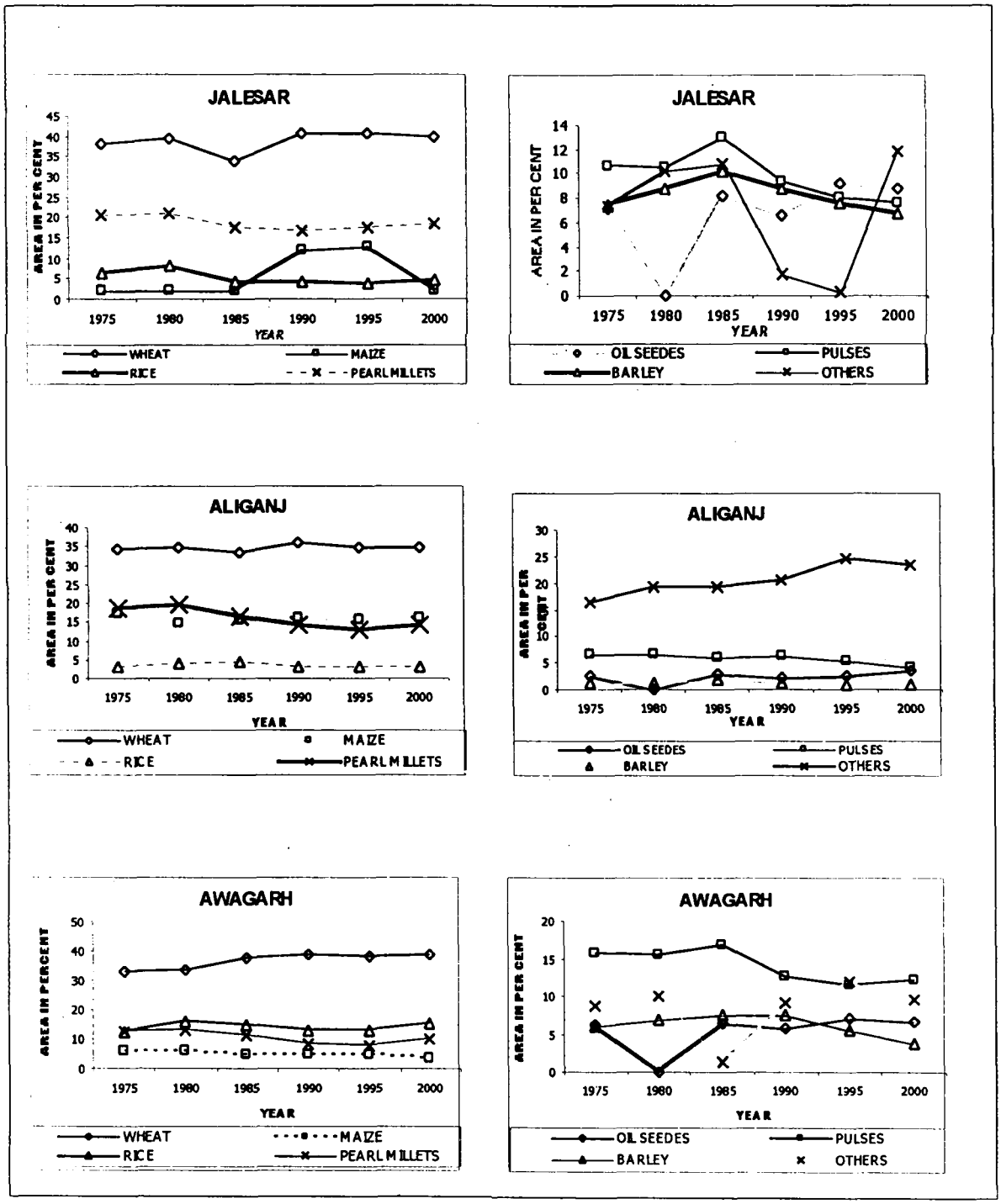


Fig -4.4

PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

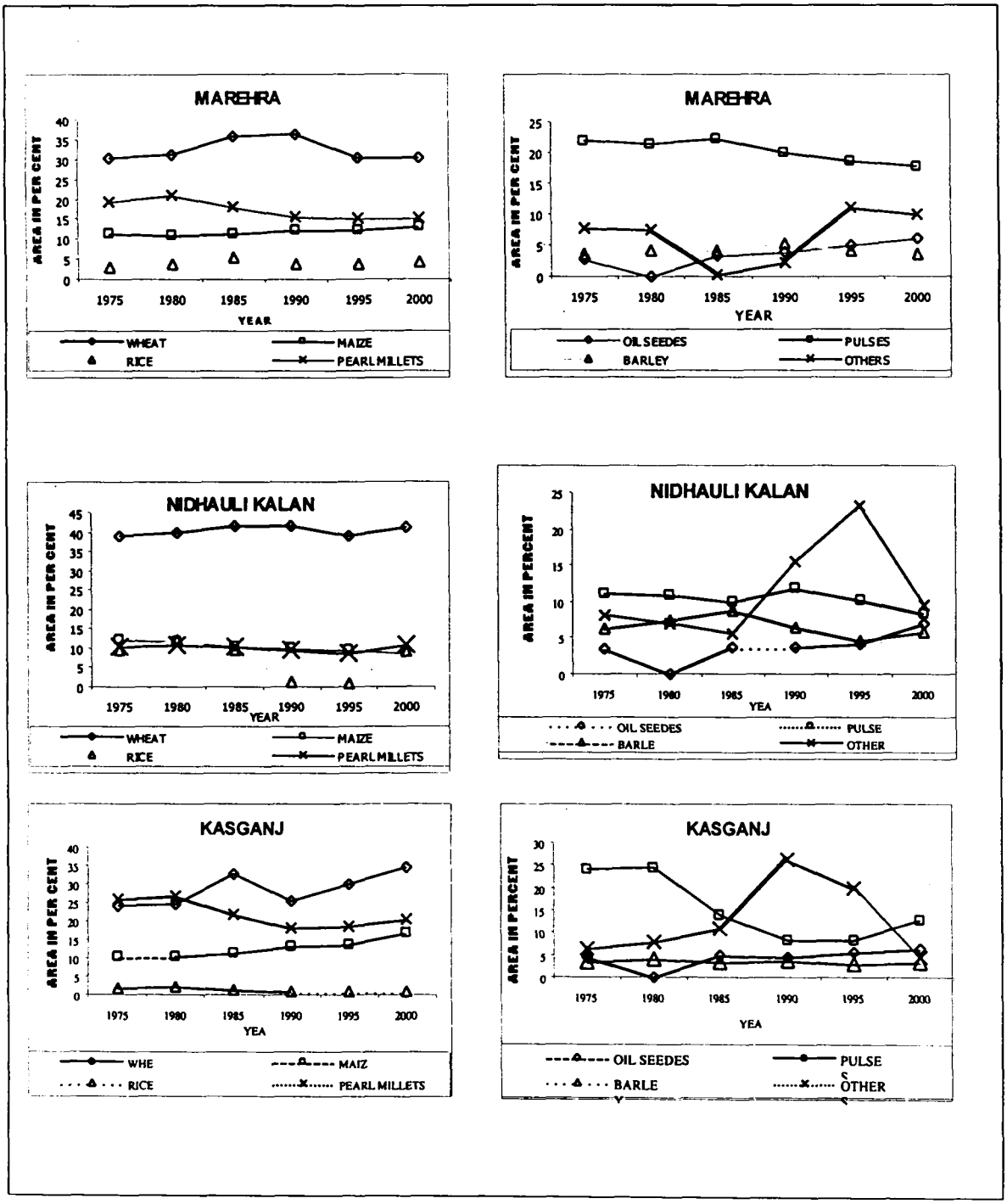


Fig -4.5

PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

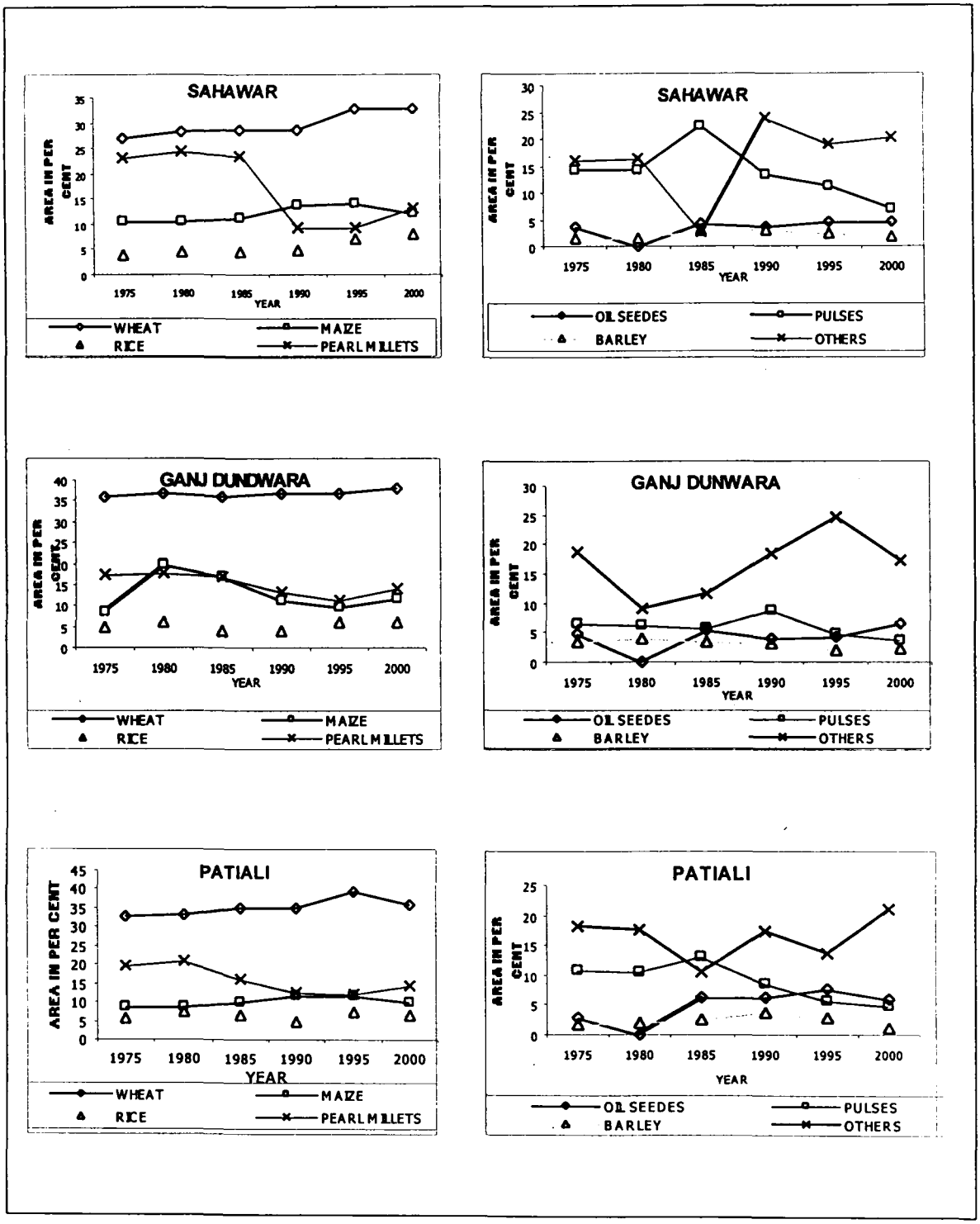


Fig -4.6

PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

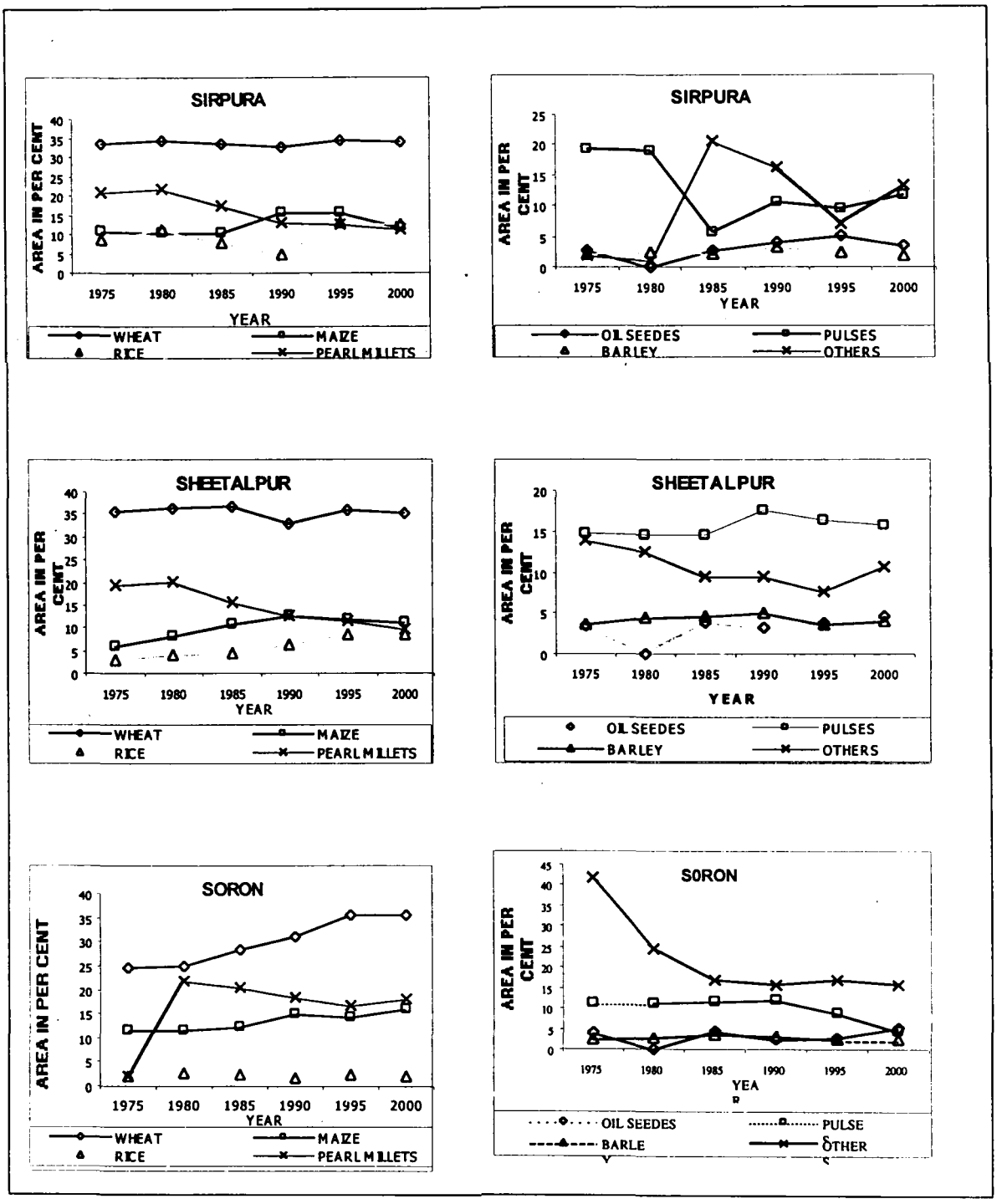


Fig -4.7

In Marehra wheat occupied 30.38 percent to the gross soon area or 7921 hectare, during the period, 1975-76. Wheat becomes a crop of first rank during the same period during the period 1980-81, the cultivated area of wheat increased in the block of Marehra. Here the wheat occupied 31.01 percent to the gross sown area or 8231 hectare during the same period. Data indicate that the lower position in comparison to other block under study. Again the cultivation of wheat in the Marehra increased during the period of 1985-86. This year wheat covered 38.93 percent to the gross cropped area or 9172 hectare. The increase in the cultivated area of wheat may be ascribed to adequate irrigation facilities and also because it constitutes staple food crop of the area. In the development block of Marehra this crop had increased its cultivated area during the period 1990-91. It occupied 36.37 percent or 10036 hectare, shrank 30.2 percent to the gross cropped area or 8887 hectare in 1995-96, and again increases to 9185 hectare or 30.1 percent to the gross sown area. This crop remains maintain its first rank in the block, throughout the period under study (Appendix and figure-4.3 to 4.7)

The figure 4.8 and 4.9 show that wheat is the first ranking crop in all the development blocks throughout the period under study. This trend may be ascribed to assured irrigation facilities; high yielding varieties of wheat, good soils, high return and the most important factor is the high demand because of the staple food crop of the region.

A detailed study of the spatial distribution of important crops in the district Etah reveals that the wheat occupied the highest percentage of cultivated area in the last two decades, i.e. 1975-2000. It is followed by pearl millets, the second important crop of the district next to wheat. A study of statistics related to pearl millets a show that

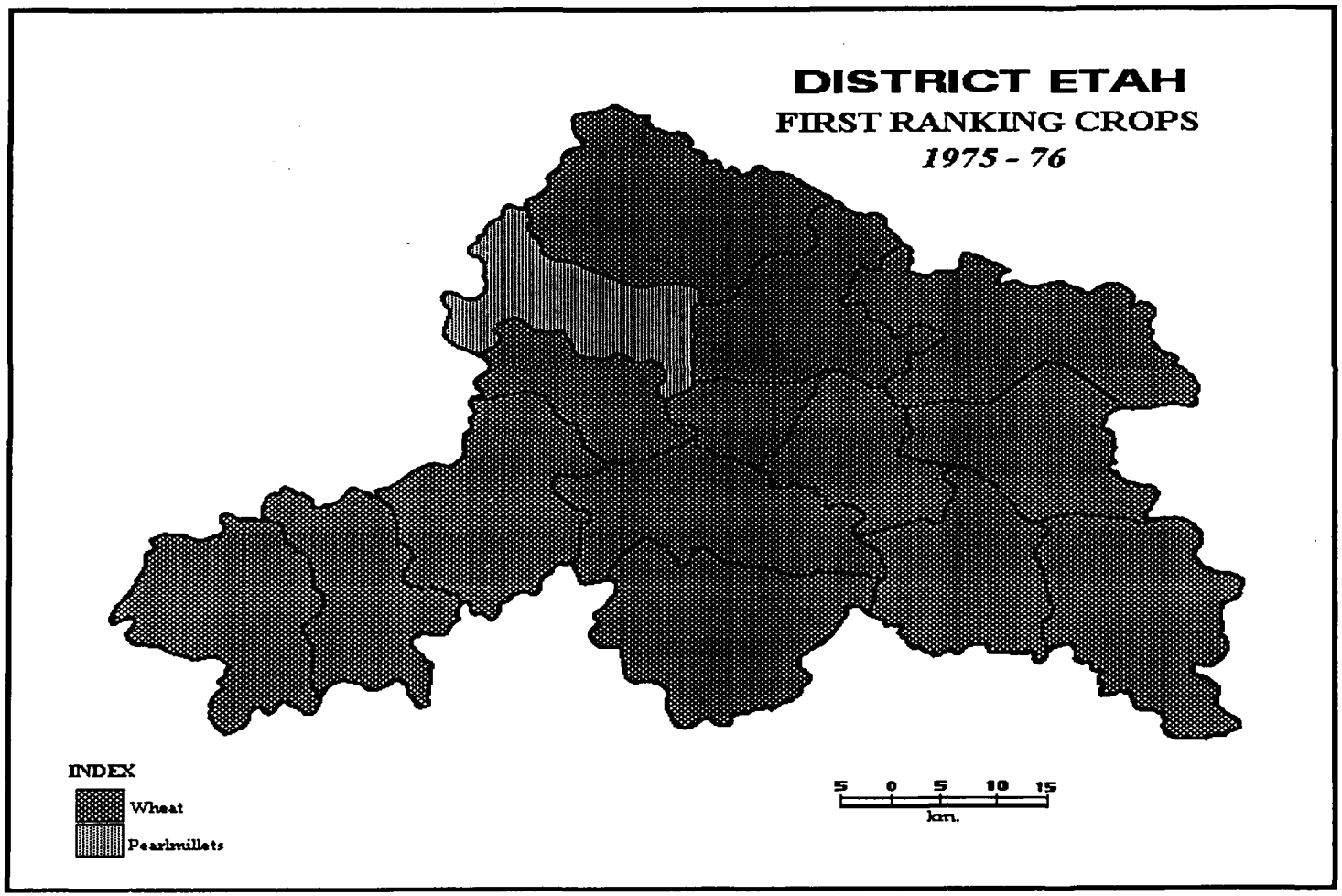

DISTRICT ETAH
FIRST RANKING CROPS
1975 - 76
INDEX
Wheat
Pearlmillets
5 0 5 10 15
km.

Fig -4.8

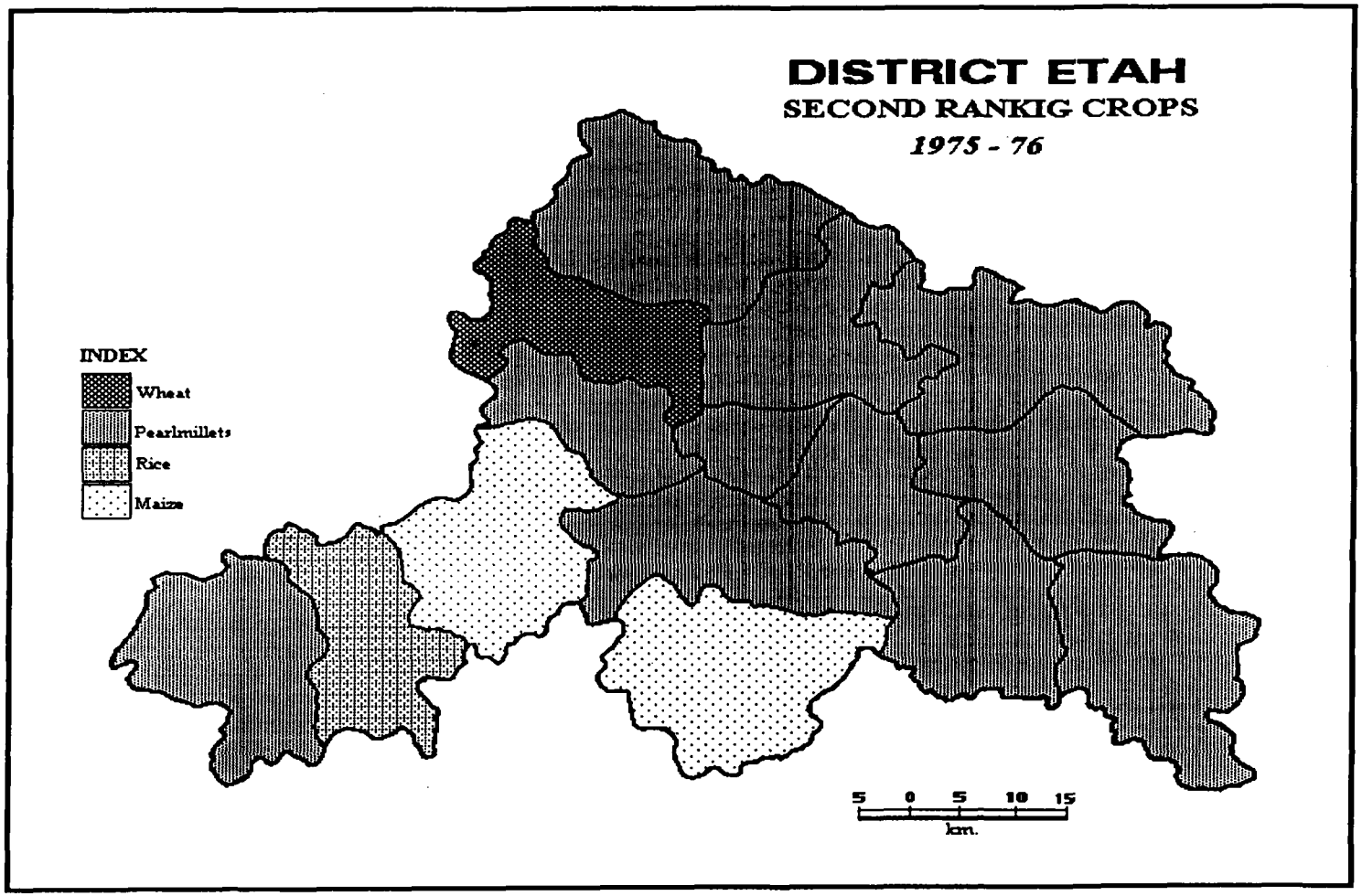

DISTRICT ETAH
SECOND RANKIG CROPS
1975 - 76
INDEX
Wheat
Pearlmillets
Rice
Maize
5 0 5 10 15
km.

Fig -4.9

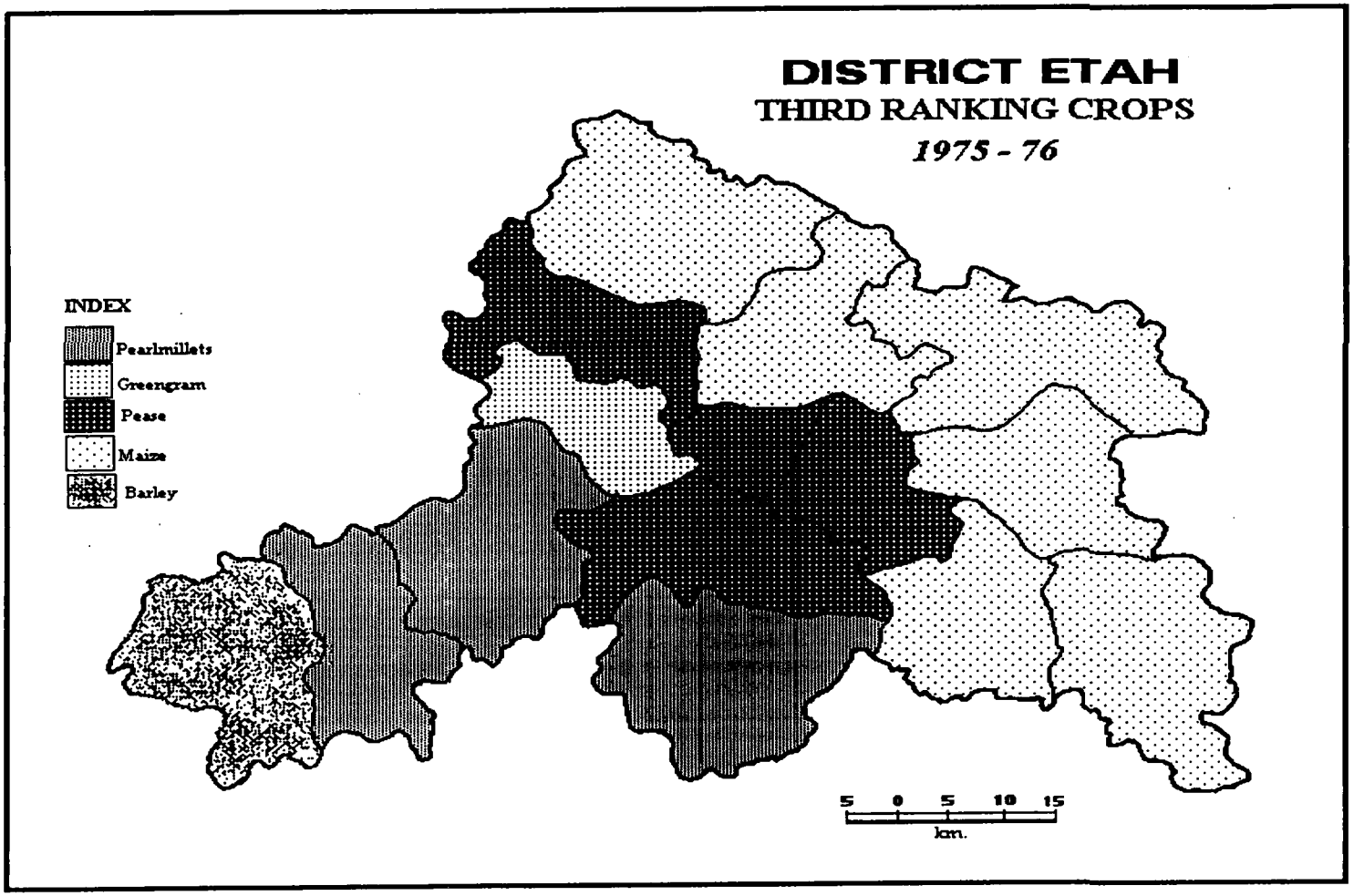

DISTRICT ETAH
THIRD RANKING CROPS
1975 - 76
INDEX
Pearlmillets
Greengram
Pease
Maize
Barley
5 0 5 10 15
km.

Fig -4.10

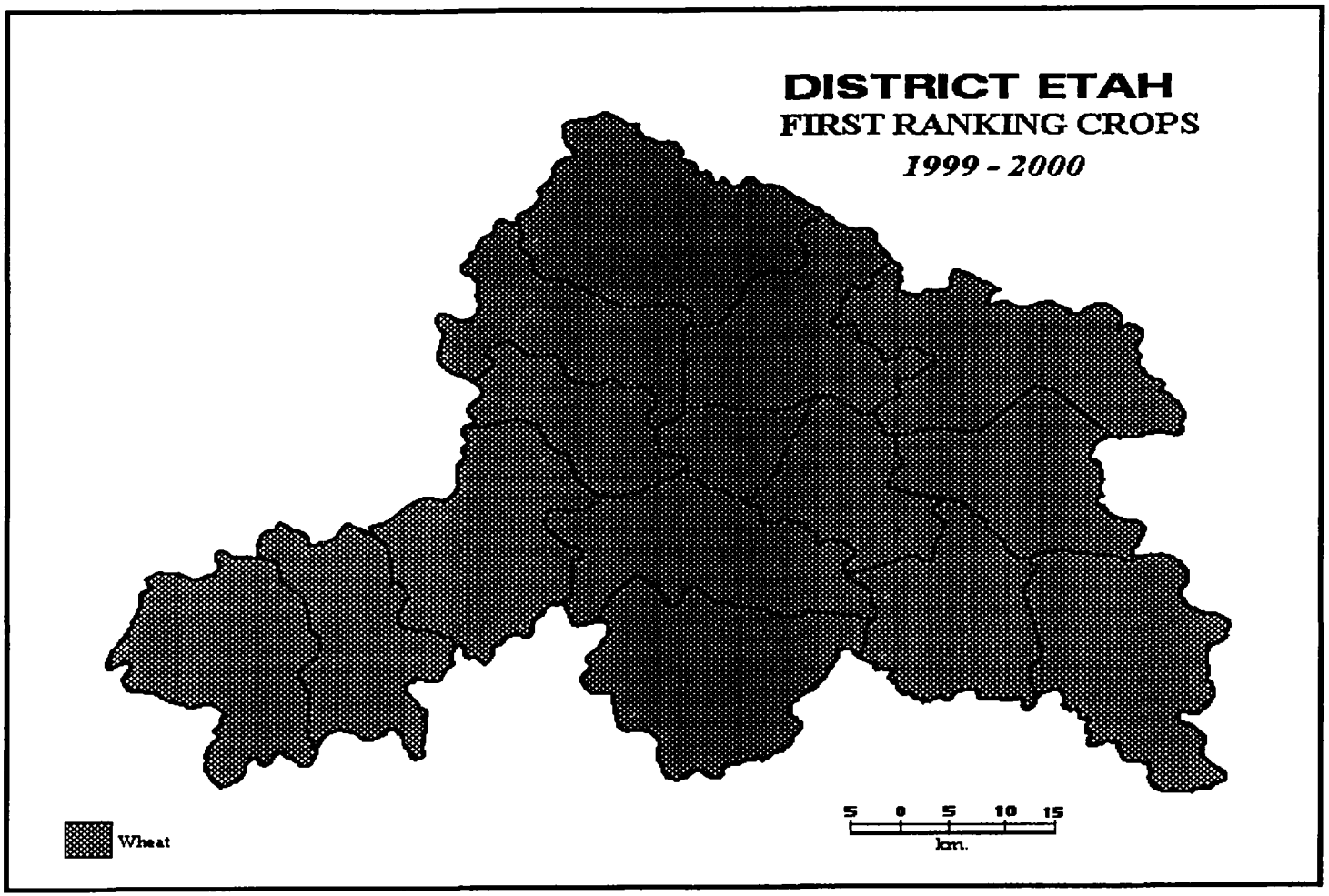

DISTRICT ETAH
FIRST RANKING CROPS
1999 - 2000
Wheat
5 0 5 10 15
km.

Fig -4.11

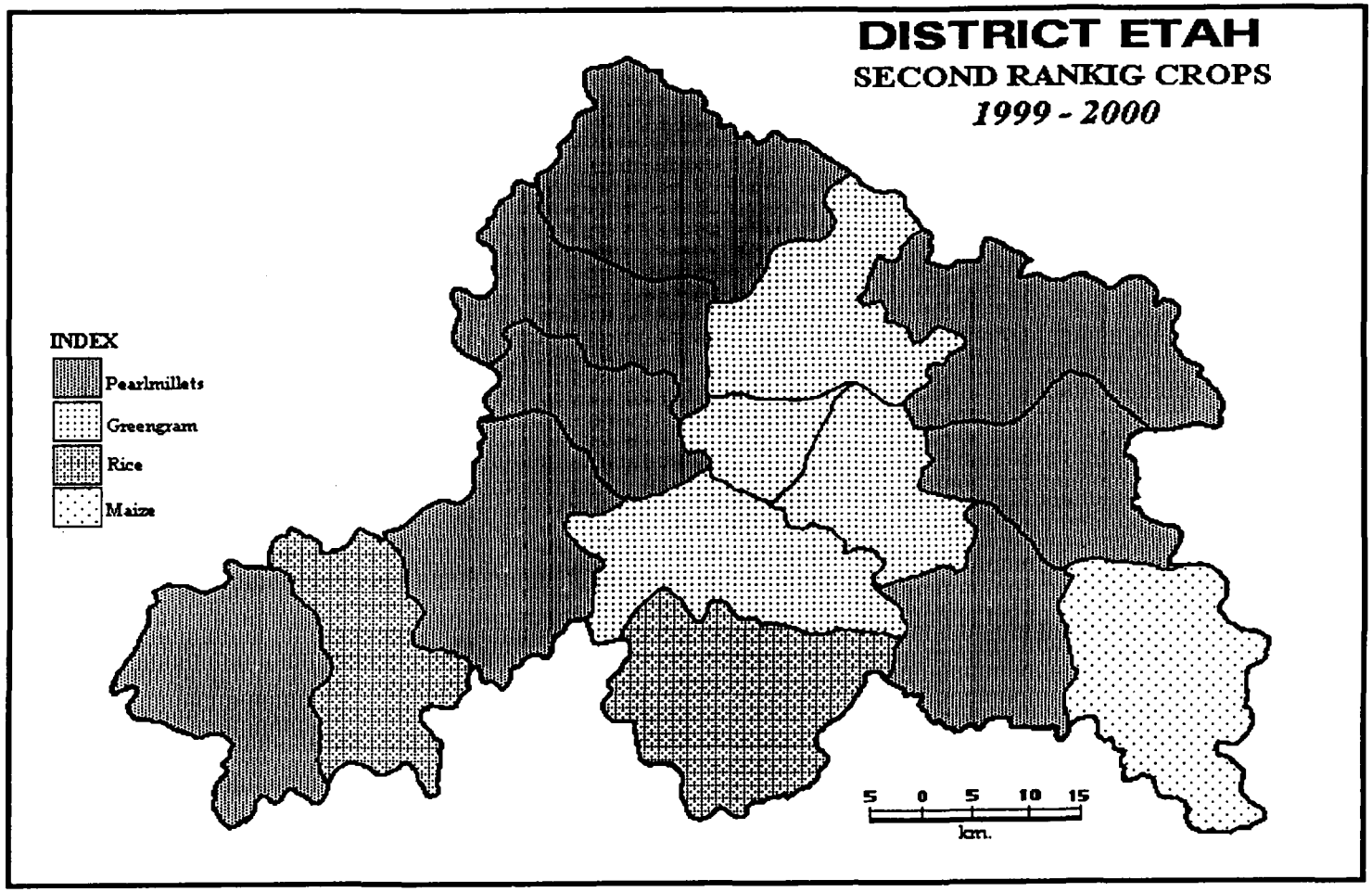

DISTRICT ETAH
SECOND RANKIG CROPS
1999 - 2000
INDEX
Pearlmillets
Greengram
Rice
Maize
5 0 5 10 15
km.

Fig -4.12

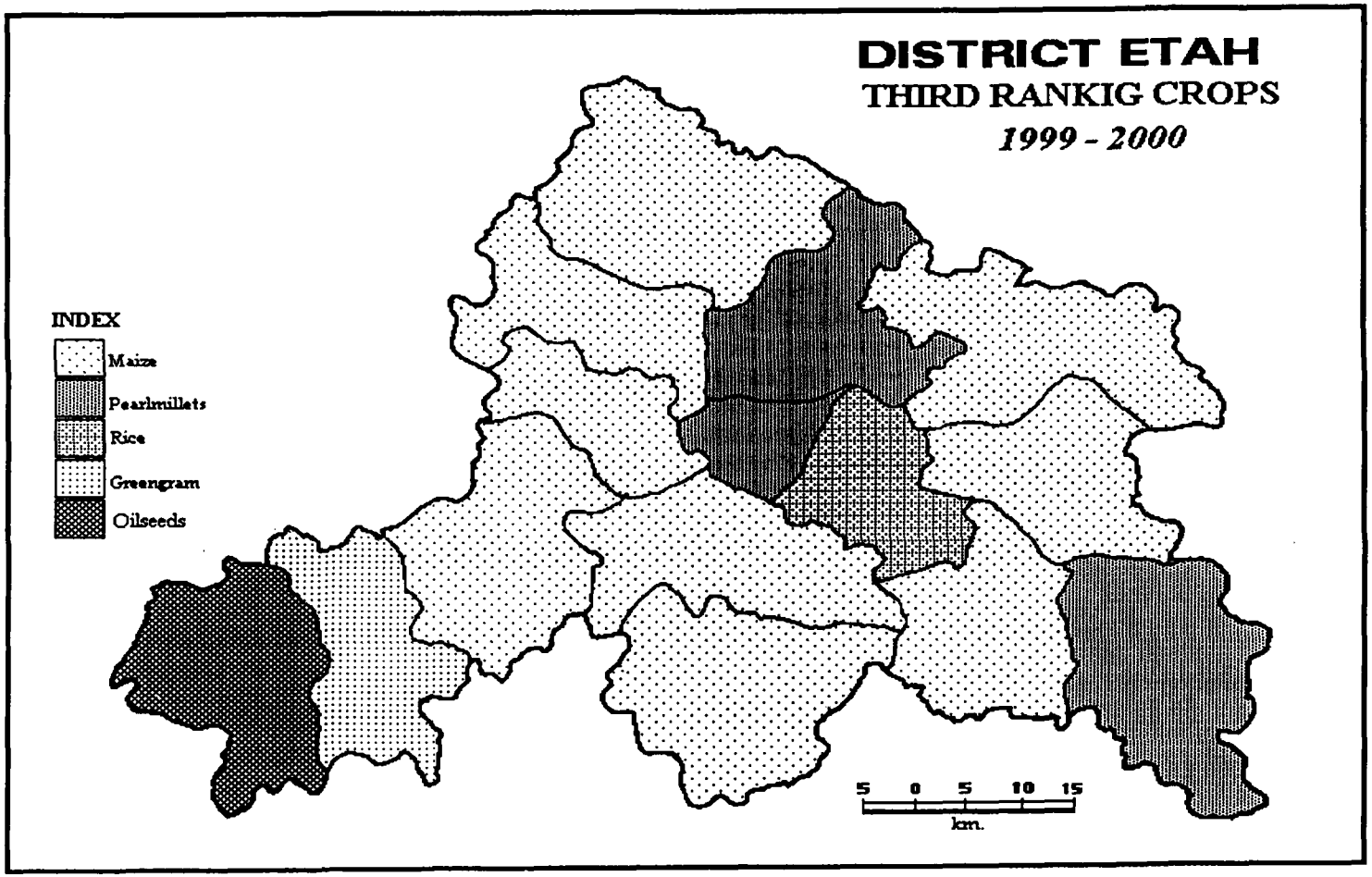

DISTRICT ETAH
THIRD RANKIG CROPS
1999 - 2000
INDEX
Maize
Pearlmillets
Rice
Greengram
Oilseeds
5 0 5 10 15
km.

Fig -4.13

in most of the blocks of the district pearl millet is cultivated in large area. In the year 1975-76, Jaithra that ideally suited to the cultivation of pearl millets devoted 27.91 percent of its gross cropped area. Kasganj with 25.98 percent of its gross cropped area followed it. The other blocks are Sahawar, Amanpur and Soron, which devoted 23.16, 22.68 and 21.3 percent of their gross cropped area respectively (Appendix-1). In the year 1980-81 all the blocks of the district represent a slight increase in pearl millets acreage. During this period in some blocks pearl millets become third ranking crop e.g. Awagarh and Sakeet. While in Kasganj pearl millet was first rank crop during the same period (1975) with 26.87 percent to its gross sown area. In the year 1985-86 all the blocks of the district shows a decrease in acreage under this crop. This decrease in the millets is due to low return. During the period of 1990-91 pearl millet acreage again slipped down in all the blocks of the district under study (Appendix-1). The highest percentage of the millets acreage was recorded from Jaithra with 18.95 percent to the gross sown area in 1995-96 and lowest percentage was reported from Sakeet since Sakeet is wheat producing area which mostly depends upon tube-well irrigation, it devoted very small acreage to this crop. In the year 1999-2000 Kasganj improved its position from 18.57 percent in 1995-96 to 20.27 percent in 1999-2000 while all other blocks reported between 11 to 16 percent of their gross cropped area in 1999-2000 (figure-4.3 to 4.7).

The third important crop of the district is maize, it is cultivated in all the blocks of the district. The highest percentage of acreage is reported from Aliganj with 17.12 percent of its gross sown area while the lowest with 0.85 percent is found in Sheetalpurr and 2.14 percent in Jaleser in the year 1975-76. During the same period 8 to 12 percent of its gross sown area was devoted to the cultivation of maize in all other block of the district. The percentage of the maize acreage in all

the blocks is same (between 8 and 12 percent) throughout the period under review with the exception of Awagarh in which 3 to 4 percent of the gross sown area devoted to the maize cultivation. The area under maize cultivation as a whole in the district shows an increase from 17.5 percent of the total cultivated (net sown) area of the district to 19.54 percent in 1999-2000. This happened because of increase in price and high yielding verities of seeds. Maize have become third rank crop in the block of Soron, Kasganj, Sahawar, Guajdurdwara, Patiali, Sirpura, Marehra, N. Kalan, Sakeet and Jaithra during the period of 1999-2000 and second ranking crop in Sheetalper and Aliganj during the same period.

Rice is also an important crop and it has a spatial distribution in the entire district. Rice flourishes generally in the strip along the canal, where it occupied good acreage in the year 1975-76. Awagarh had the highest percentage of the acreage under this crop with 12.44 percent of its gross sown area. During 1980-81 Awagarh have first place in the acreage with 13.58 percent of the total rice acreage in area under study (Appendix-1). Nidhauli Kalan followed it with 12.41 percent of the total rice acreage in the district during the same period. However there was ample increase under this crop in the block of Soron, Sakeet, Amanpur, Aliganj, Jaleser etc. during the period of 1975-80 beside the above noted block.

The year 1985, 1990, 1995 and 2000 show appreciable increase in the area under the rice crop particularly in the development block Sakeet 10.46 percent 12.6 percent and 13.78 percent to the gross cropped area Awagarh with 14.5 (4239 hectare), 13.17 (3916 hectare), 12.99 (4365 hectare) and 15.56 (5145 hectare) percent to the gross cropped area respectively. It is observed that after a gap of two decades, rice improved its position in all the blocks particularly in Sheetalpur, Patiali and Awagarh. While in some other blocks, the

position with regards to cultivation of rice deteriorated particularly in Jaleser and Kasganj. Other crops like peas, oil seeds barley and gram occupy only small patches in almost all the blocks of the district under study. During the period under study, these crops which have been referred in the earlier lines have some pattern of the area distribution in the entire state. The decrease in the acreage under maize and millet in most of blocks of the district is perhaps due to more emphasis given to the wheat and oil seeds during the same period. Area under oil-seeds also improved very much in the same year and Soron have first rank with 5.45 percent of it gross cropped area or 2668 hectare under oil seed cultivation and followed by Nidhauli Kalan 2488 hectare on 6.84 percent of its gross cropped area.

Pulses include pigeon Pea, green gram, lentils and Peas. The first three verities of pulses are grown over some area almost in all the blocks of the district. Green gram constitutes an important crop of the blocks of Kasganj and Amanpur. The percentage of land under green gram varies between 5.02 (809 hectare) percent to the gross cropped area in 1975 and 14.13 percent (1868 hectare) in 1999-2000, in Sahawar. The areas under the Peas and gram have decreases in all the blocks during the period of under study. In Soron there is a decrease in the acreage of Peas from 2 percent of its gross cropped area or 611 hectare in 1975-76 to 1.6 percent or 502 hectare in 1980-81, 0.5 percent or 194 hectare in 1985-86, 0.7 percent or 230 hectare 1990-91, 0.57 percent or 213 hectare in 1995-96 and 0.59 percent or 346 hectare in 1999-2000 (Appendix-1). All the blocks of the district under study have represented a decreasing trend in acreage under the crops of peas and gram, throughout the period under study. This is because of the farmers are concentrated more on high yielding varieties of seeds, of wheat, maize and rice, and high returns. The major positions

of these crops acreage have shifted under the potato and wheat cultivation.

Besides these crops, which have been studied in detailed, there are some other crops like tobacco, and sugar cane. Tobacco is the third ranking crop of Aliganj while in other blocks it is cultivated over small areas in some of the blocks of the district, their percentages are low and hence they have not been studied in the greater details. However, almost all the important of the *Kharif* and Rabi season are cultivated in the entire region with marked variation in acreage under these crops.

THE TOTAL VOLUME OF CHANGE:

Having thus examined all the leading occupiers' cropland individually, of district Etah, it may logically proceed to a summation of the accumulated patterns of change among the major crops as a group. With the exception of a few specialty types of crop production offending a limited number blocks, such as tobacco in Aliganj. A tallying of the percentage points of increase and decrease among these crops, therefore, is taken to provide a reasonably accurate comparative measure of the total volume of change that has occurred over the period under review on the harvested crop land of the district Etah.

The procedure, which has been followed, is rather simple. For each of the 15 development blocks of the region under study abbreviated fractional expressions were prepared showing the size of the percentage point increase or decrease that occurred within the development block for any of the major crops found there. A crop identifying letter, together with any existing percentage point of increase where placed in the numerator position of the fraction and an identifying latter together with an existing decrease value was placed in the denominator. The percentage point values of the numerator and

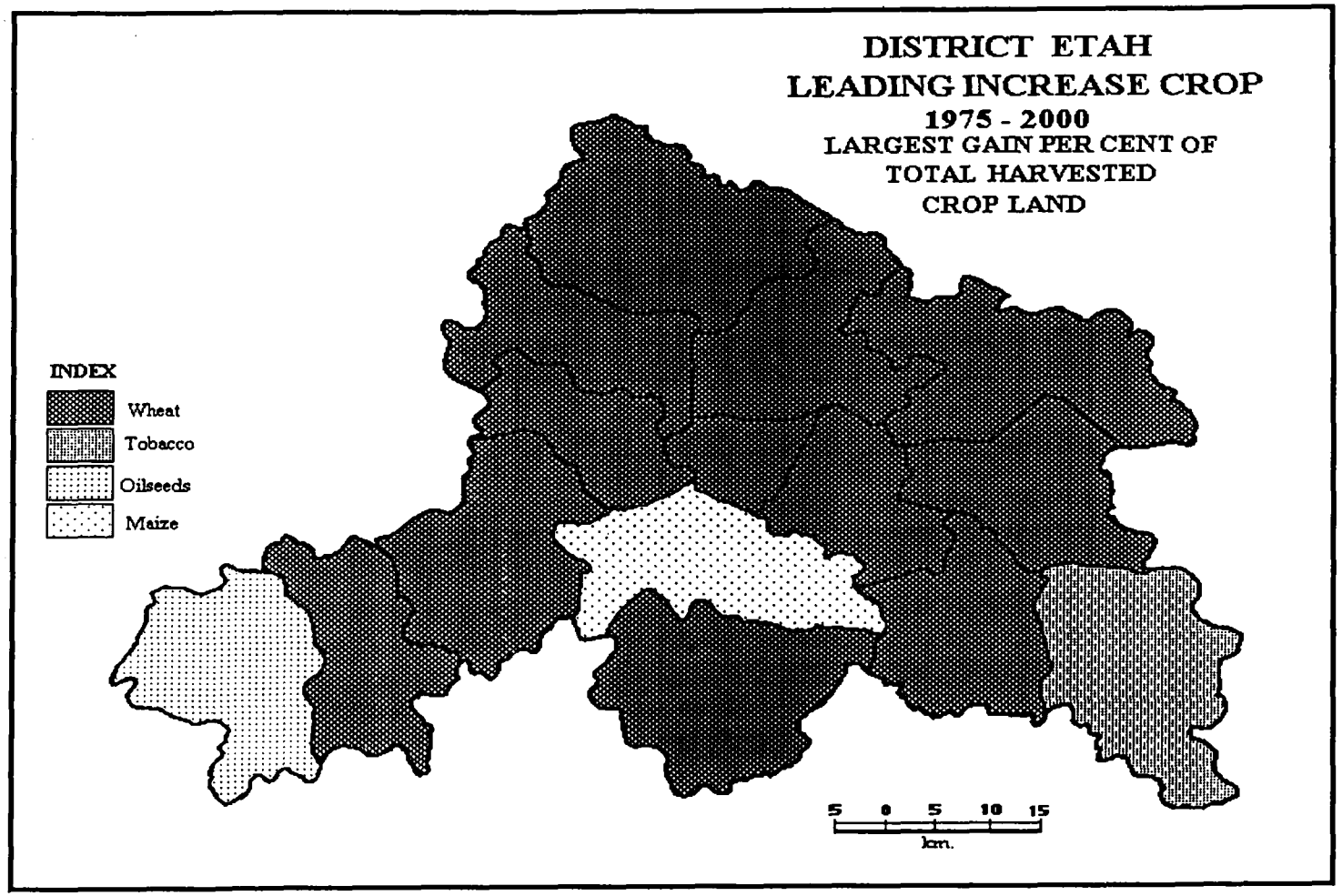

DISTRICT ETAH
LEADING INCREASE CROP
1975 - 2000
LARGEST GAIN PER CENT OF
TOTAL HARVESTED
CROP LAND
INDEX
Wheat
Tobacco
Oilseeds
Maize
5 0 5 10 15
km.

Fig -4.14

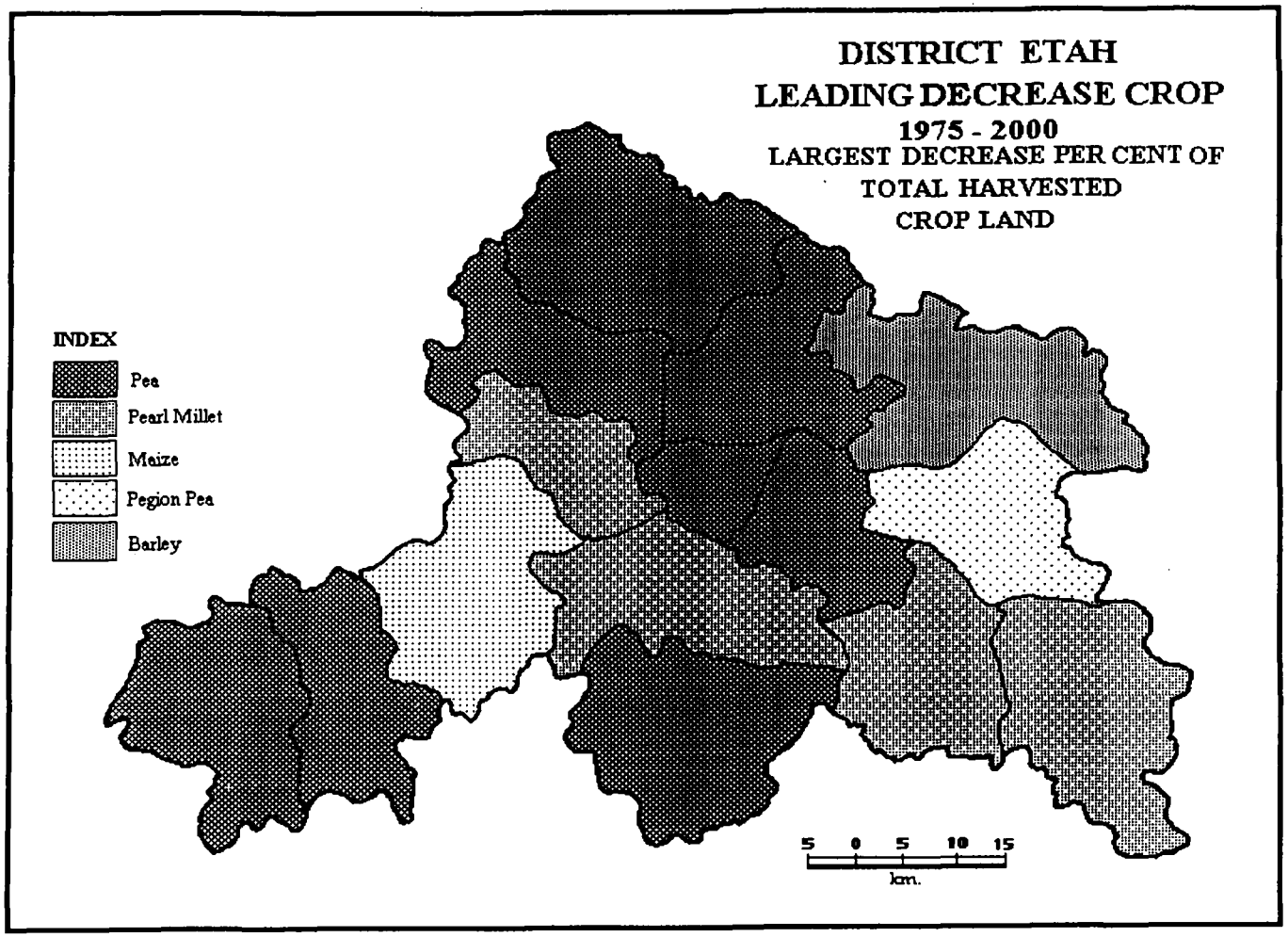

DISTRICT ETAH
LEADING DECREASE CROP
1975 - 2000
LARGEST DECREASE PER CENT OF
TOTAL HARVESTED
CROP LAND
INDEX
Pea
Pearl Millet
Maize
Pegion Pea
Barley
5 0 5 10 15
km.

Fig -4.15

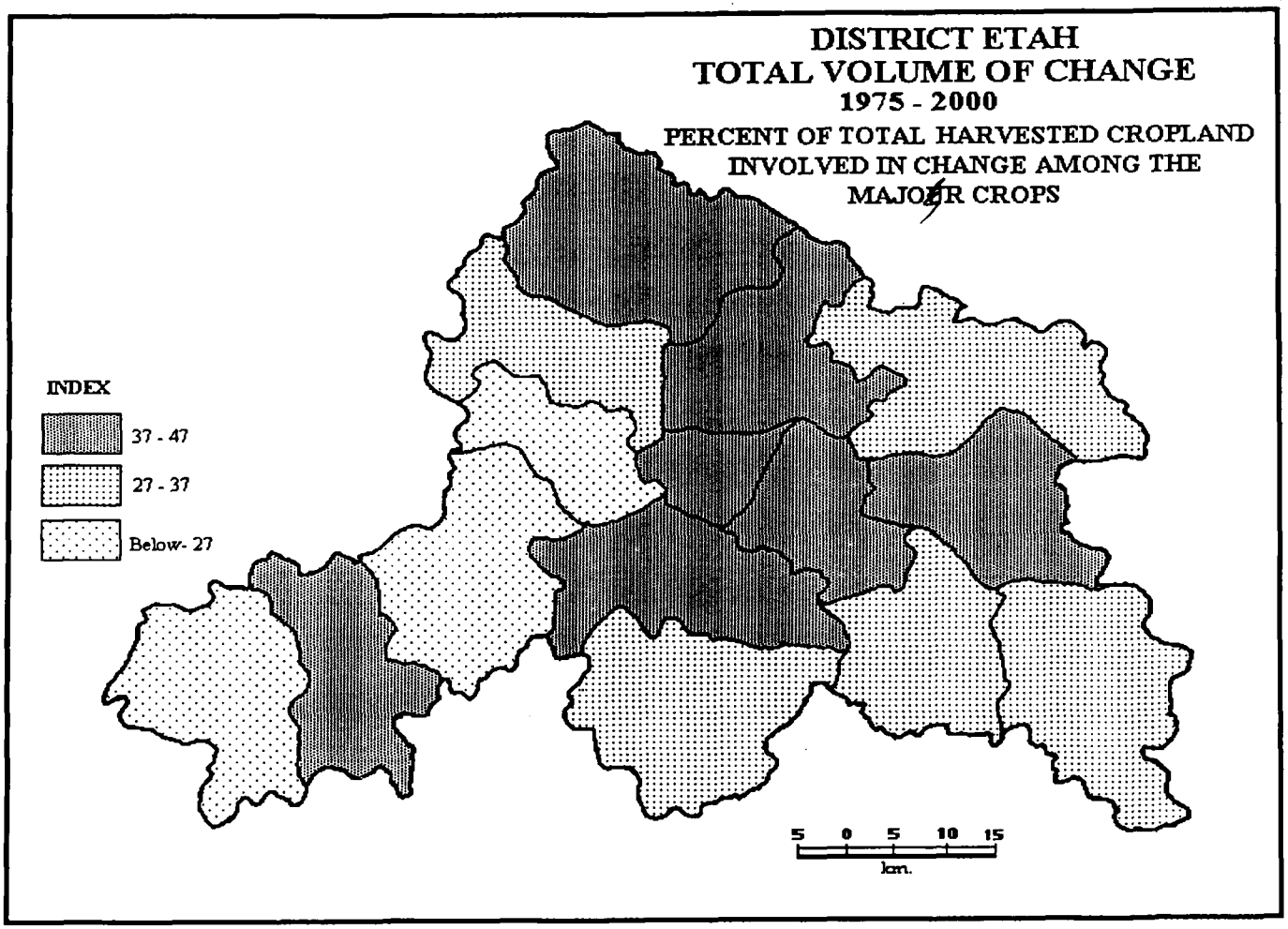

DISTRICT ETAH
TOTAL VOLUME OF CHANGE
1975 - 2000
PERCENT OF TOTAL HARVESTED CROPLAND
INVOLVED IN CHANGE AMONG THE
MAJOR CROPS
INDEX
37 - 47
27 - 37
Below- 27
5 0 5 10 15
km.

Fig -4.16

denominator have been added up separately, the two seems then to indicating a numerical fraction. On the basis of these computations an index has been made available for indicating the total percentage of the harvested crop land affected in a given development block as a result of changes in the relative strength of the major crops.Supposing that after the computation, the fraction 50/45 for a particular block is obtained it would indicate that 50 percent of the harvested land increase under other crops. The larger of the two digits has therefore been plotted on the map for that development block. An interesting fact is that in virtually every block in which the numerator and denominator did not balance, the numerator was the larger of the two figures. Clearly this indicates a general tendency throughout the district for the major crops to have further strengthened their land holding position at the expense of minor crops.

Having thus achieved a measure of the percentage of that harvested cropland involved in change among the ten major crops for every block, the result appears in figure-4.16, a map which provides a comparative view of the areas where the cropland use pattern have been relatively dynamic and where by contrast they have been relatively stable. Blocks, where shift among the major crops effected 20 percent or more of the total harvested cropland are given one type of shading and may be designated as out standing areas of change. On the other hand blocks, where the changes having effected less than 20 percent of the total harvested crop land are given a second type of shading and these may be described as having been relatively stable during the period under observation.

In examining figure- 4.16, it will be noted that conditions of relative stability prevailed throughout much of the heart of the mapped area from north east Ganjdundwara through Sahawar Amanpur Sheetalput to the Sakeet in the south. There is no block in

the district (With an exception Jalesar), which has gained less than 10 percent of the gross cropped area during the period under review.

Jalesar is the only block, which has got 8.1 percent of the gross sown area by the main crops under study. It comes under the stable region. Maximum percentages of total gross sown area, affected by change within these dynamic areas have reached as high as 37-37 in Soron and 34-09 percent of the gross sown areas in Ganjdundwara.

As by products of the summation analysis of change, diagrams are prepared for each block which represent the crops made percentage gain or loss in relation to the gross cropped area (figure-4.14 and 4.15). The examination of figures shows that wheat is the only crop, which has got largest percentage of gross sown area during the period under study while peas have lost maximum percentage of the cropped area.

Wheat, rice, oil seeds and potatoes are speeding in their area extent. This spared in these crops are due to the assured irrigation facilities, high productivity and demand of these product. The crops such as peas, pigeon peas, Sugar cane and pearl millets are decreasing in their area extent. The decrease in these crops is due to the demand of intensive labour and low return.

CROP COMBINATION:

Comprehensive understanding of crop combination of region provides a scientific basis for agricultural regionalization. No crop is grown in isolation from other crops in a given areal unit at a given point of time; however crops are grown in combination. Crop combination is of great significance for regionalization of the agricultural development.

The present study focuses upon the analysis of crop combination in the district Etah of U.P. with keeping in mind of

following objectives, first to find out the set of those crops which are dominating in economy of each development block of the district Etah, second to explore to the patterns and changes in crop in crop combination.

Various geographers and social scientists to outline the crop combinations in different parts of the world have used a number of statistical techniques. Some geographers and social scientists have adopted the Weaver's method other methods opted like that of S.M. Rafiullah's method of cropping intensity[3].

In the present analysis the principles of Weaver technique regarding the calculation of crop combination region has been used. In his work Weaver calculated deviation from the real percentage of crops for all possible combination in the component areal units against a theoretical standard. The theoretical curve for the standard measurement was employed as given below:

Monoculture: 100 percent of the total harvested crop land in one crop.

2 crop Combination: 50 percent in each of two crops.

3 crop combination: 33⅓ percent in each of there crops and so on down the scale.

Minimum deviation has determined systematically through the standard deviation method as given below:

$$SQ = \frac{\sqrt{\leqslant d^2}}{n}$$

where 'd' is the difference between actual crop percentages in a given area unit and appropriate percentages in theoretical curve and 'n' is the number of crops in a given combination. As Weaver pointed out that relative values and not obsolete values are significant, square roots were not extracted so that actual formula was used as follows:

$$d = \frac{d^2}{n}$$

Weaver's method results into suitable and accurate grouping of crops.

CROP COMBINATION OF DYNAMIC CHANGE:

Crop Combination regions based on Weaver's method worked out for the year 1975-76 and 1999-2000 has been plotted in the figure 4.17 and 4.18 It may be concluded that there are four, five, six and seven crops combination in the district Etah. In all the crops involved in combination are most which occupied more than five percent of the total cropped area.

The combinational behavior of change will, of course, have its greatest interest and significance in those areas where the total volume of land affected by change has been ~~most outstanding~~. Block level study has been chosen in the district Etah. For the analysis, entries were made in each of the block within the district showing all the crop combination of1975-76 as well as 1999-2000 (Fig 4.17& 4.18).

Six blocks in the district were reported four crop combination, namely Aliganj, Jaithra, Jalesar, Sirpura, Soron and Kasganj in 1999-2000. In all the combination three crops are common e.g. wheat, pearl millet and maize while fourth one is varies, from one block to the other.

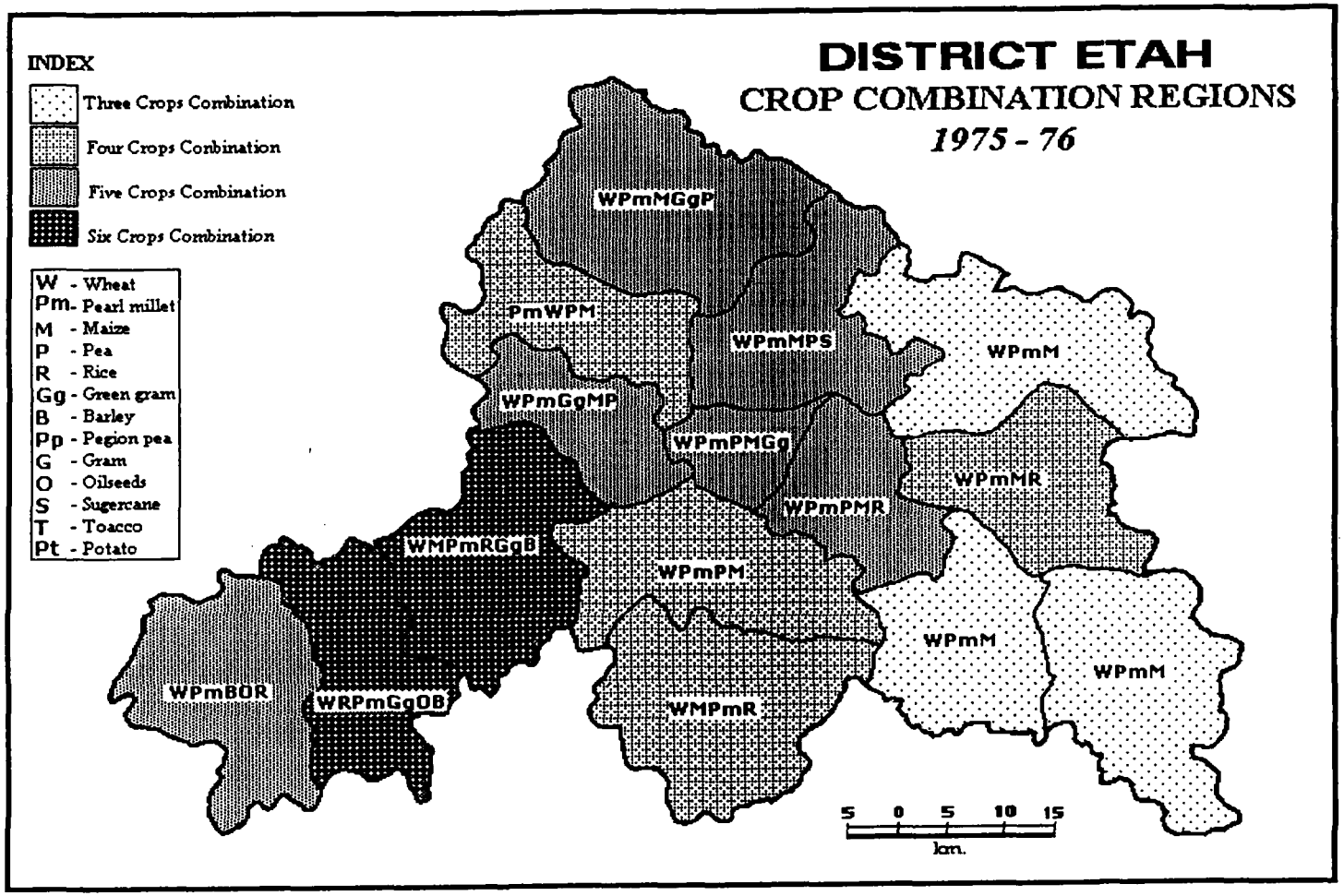

INDEX
Three Crops Combination
Four Crops Combination
Five Crops Combination
Six Crops Combination
W - Wheat
Pm- Pearl millet
M - Maize
P - Pea
R - Rice
Gg - Green gram
B - Barley
Pp - Pegion pea
G - Gram
O - Oilseeds
S - Sugercane
T - Toacco
Pt - Potato
DISTRICT ETAH
CROP COMBINATION REGIONS
1975 - 76
WPmMGgP
PmWPM
WPmMPS
WPmM
WPmGgMP
WPmPMGg
WPmMR
WPmPMR
WMPmRGgB
WPmPM
WPmM
WPmM
WPmBOR
WRPmGgOB
WMPmR
5 0 5 10 15
km.

Fig -4.17

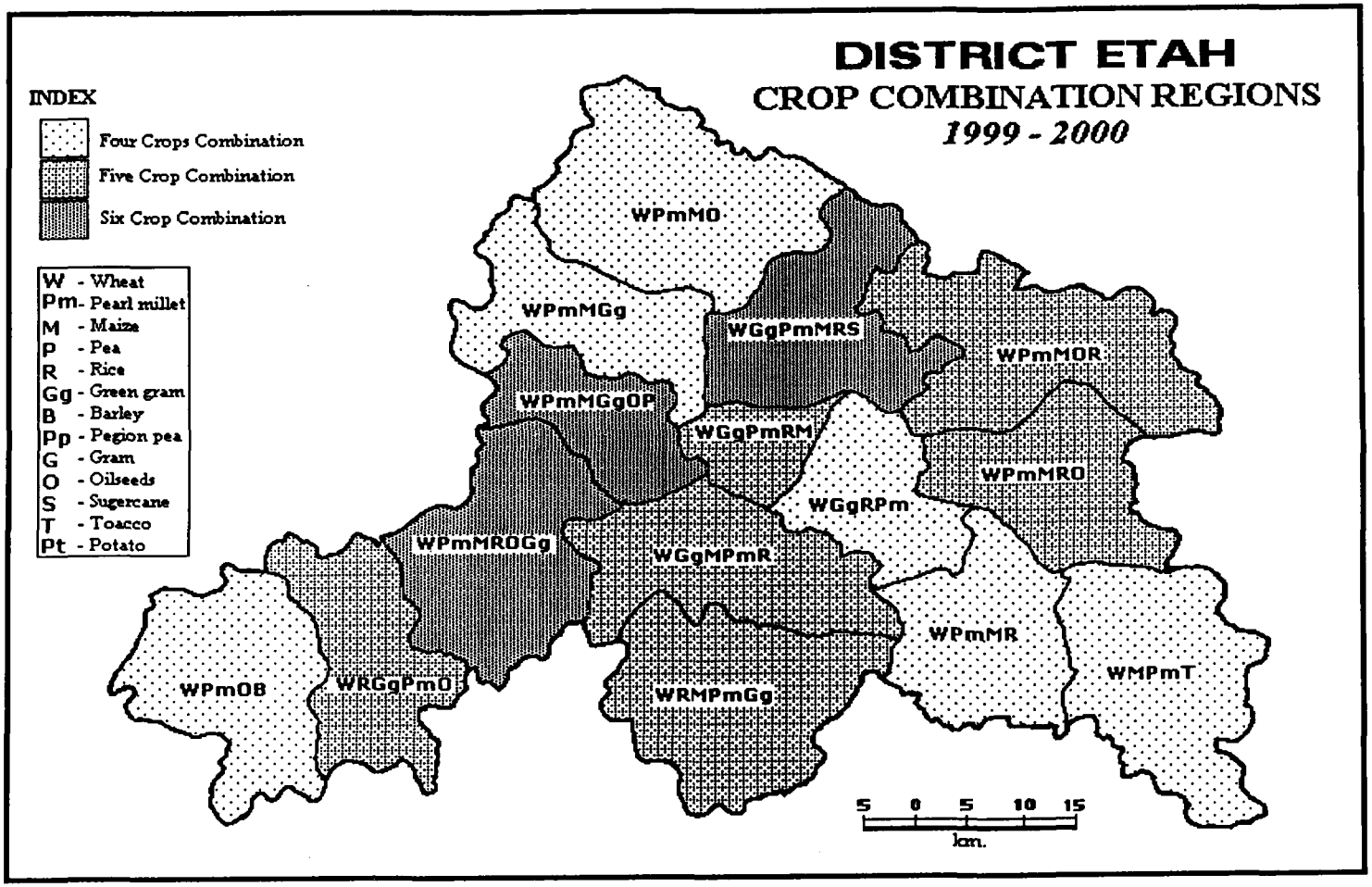

DISTRICT ETAH
CROP COMBINATION REGIONS
1999 - 2000
INDEX
Four Crops Combination
Five Crop Combination
Six Crop Combination
W - Wheat
Pm- Pearl millet
M - Maize
P - Pea
R - Rice
Gg - Green gram
B - Barley
Pp - Pegion pea
G - Gram
O - Oilseeds
S - Sugercane
T - Toacco
Pt - Potato
WPmMO
WPmMGg
WGgPmMRS
WPmMOR
WPmMGgOP
WGgPmRM
WPmMRO
WGgRPm
WPmMROGg
WGgMPmR
WPmMR
WMPmT
WPmOB
WRGgPmO
WRMPmGg
5 0 5 10 15
km.

Fig -4.18

In 1975, two blocks, Jaithra and Aliganj were three crop combination i. e. wheat, pearl millet and maize in each block, while the Jalesar, Sirpura and Soron were five crop combination region, the crops in this region wheat, pearl millet, barley, oil seeds and rice in Jalesar, wheat, pearl millet, pea, maize and rice in Sirpura and wheat, pearl millet, maize, green gram and pea in Soron. The development block Kasganj was four crop combination region in 1975 with the crops- pearl millet, wheat, pea and maize ; Kasganj was remains four crop combination region with the crops wheat, pearl millet, maize and green gram.It shows that the numbers of crops in the combination are same but the sequences have changed, i.e. wheat has replaced to the pearl millet from the first rank to the second and the green gram replaces the pea out from the combination.

Five crop combination regions include the development block of Amanpur, Patiali, Sakeet, Ganjdundwara, Awagarh and Sheetalpur in the region under study. Two blocks Patiali and Ganjdundwara have same crops in the combination with a change in the place of fourth and fifth crop, i.e. oil seeds and rice; and other first, second and third crops are wheat, pearl millet and maize. These two blocks (Patiali and Ganjdundwara) have identical location. In 1975-76, Ganjdundwara was three crop combinations and Patiali was four crop combination regions with the crops wheat, pearl millet, maize and rice. Both Sakeet and Awagarh is five crop combination regions, but the rank of crops in the combination is different from other five crop combinations, i.e. rice is the second ranking crop in this combination and cash crop, green gram is the third and fourth ranking crop. In 1975-76 Sakeet was four crop combination region with the crop wheat, maize, pearl millet and rice, while Awagarh was six crop combination with the crops wheat, rice, pearl millet, green gram, oil seeds and barley. Amanpur and Sheetalpur development blocks which

are five crop combination regions, have green gram as a second ranking crop; it shows that in these blocks the farming system have transformed from subsistence to commercialized agricultural system.

Three blocks namely Sahawar, Marehra and Nidhaulikalan fall in the category of six crops combination. Sahawar and Marehra were five crops combination region in 1975-76, the crops in the combination were different from each other i.e. wheat, pearl millet, maize, pea and sugarcane in Sahawar and wheat, pearl millet, green gram, maize and pea but the addition of the six crop in these block is also not same i.e. rice in Sahawar with fifth rank and oilseeds in Marehra with the fifth rank too. In all the six crop combinations region only those crops are introduced of which high yielding varieties have become available in the market i.e. rice and the cash crops (green gram, oilseeds etc.).

In subsequent studies of the factors involved in producing crop land use changes, such a crop-combination behavior of districts obviously has a high level of utility. In their competitive relations specific crops do indeed assume elements of comparative strength and weakness in their on individual right, but atleast equally significant, (and perhaps even more demanding of careful scrutiny) are the elements of strength and weakness that derive from the favorable and unfavorable association of one crops with another. This is to recognize the fact that often the production management relationship between two or more crops are such as to give to each individual in a combination, is more advantageous or disadvantageous position than it would have if considered alone and by itself.

From the (Appendix-1) it is clear that wheat is the most important crop among all the crops grown in the district Etah. It enters into combination with other crops as a first ranking crop in all the blocks of the district. The farmers under physico-social conditions

prefer to devote their arable land to several crops. The high diversification of crops is based on the assumption of perfect certainty. ~~Relation of~~ This assumption may have considerable bearing ~~up~~ on the decision making of the farmers. Generally, the farmers of most of the blocks are interested in the cultivation of wheat, maize, pearl millet and oilseeds which shows that agricultural economy in the region is mainly market oriented.

Why does a combination of many crops restrict in higher profits?

Reference:

1. Shafi M., (1965) 'Pattern of Crop Land Use in the Ganga Yamuna doab' *The Geographer* , Vol. XII, P. 13.

2. Shafi, M., (Jan.1954) 'Measurement of Agricultural Efficiency in U.P.' *Economic Geography,* Vol. –XXX, No. 1.

3. Rafiulla, S.M., (1965) 'A New Approach to Functional Classification of Towns' *The Geographer,* Vol. XII, p. 48.

4. Weaver, J.C., (1954), 'Crop Combination Regions in Middle West' *Geographical Review,* Vol. XLVI, No. 4, pp. 173-200.

Chapter - 5

Problems of the Introduction of Green Revolution

PROBLEMS OF THE INTRODUCTION OF GREEN REVOLUTION

Prior to the introduction of new agricultural strategy in mid sixties, the crop production had largely increased by the detention of area under cultivation. This practice of increasing food grain production could neither be sustained for a longer time nor was it commensurate with increasing requirements of food grains for the teeming millions. Whenever monsoon failed, severe drought and famine conditions followed. To prevent starvation, there was no alternative but to import food grains. It went on for years and the country's finance was put under tremendous strain every time. This bitter experience induced the planners and policy makers to give top most priority to attaining self-sufficiency in food. To fulfill this paramount objective a new agricultural strategy, popularly known as 'green revolution', was adopted in the mid sixties.

This strategy involved the use of modern technology, including HYV seeds, chemical fertilizers, irrigation facilities, improved farm implements and crop protection measures. These endeavors in the direction of increasing food grain production succeeded, not only in attaining self sufficiency in it, but also took care of building an adequate buffer stock to meet any adverse eventuality. Further, India has become capable of exporting food grains as well. No doubt, the new technology has increased agricultural production, but it has created several environmental problems.

The agricultural situation in the state changed dramatically as a consequence of consolidation of holding, availability of canal water, tube-well irrigation and with strong research and extension education

components that developed close interactive relationship with the state agriculturist. Introduction of dwarf wheat germ plasm and cultivators in 1964 – 65, which could easily stand to higher use of fertilizers without lodging and required assured irrigations, set the stage for wheat based green revolution in the state.

With this conducive production environment, assured remunerative prices provided by the govt. through the price support and procurement systems as well as spread of rural and approach roads network in the state, production and productivity as well as grass domestic product from agriculture sector started improving quite fast. Tractors and tube-wells started dotting the landscape everywhere; uses of fertilizers and pesticides expanded and irrigated area as well as intensity of cropping started increasing. Even net sown area also increased, and cropping pattern started witnessing significant changes. The foundation of green revolution was thus laid and infrastructural, technological and economic environments was rendered conducive for the interaction of elements of growth and productivity in the state.

Cropping pattern underwent significant changes with area under wheat increasing from about 30 percent to 39 percent of the total cropped area. Percentage area under pulses declined drastically from over 13.86 to 9.00 percent in the area under study. As a result production of food grains in 1999-2000, more than doubled. Rice had not as yet caught the imagination of the farmers although area under the crop and production had started increasing. From here on agricultural sector growth made a quantum-jump. Yet, with the industrial and tertiary sector too growing fast, share of agricultural sector in the GDP started declining which in tune with classic model of growth and development of any economy. This growth in agriculture initiated by green revolution in wheat crop production in

late sixties and fuelled by rice revaluation in mid seventies, continued un-abated under conducive commercial environment both on production as well as market front.

With cropping intensity of 175, wheat occupied 40 percent of the gross cropped area with rice occupied 10 percent. The production of coarse grains got marginalized. Relative area under pulses and sugar cane decreased.

This conducive economic environment gave impetus to expansion of tube-well irrigation, tractor cultivation and intensive use of fertilizers. As a consequence fertilizers use increased to 112.8 kg. per hectare of grass sown area and pesticides use increased manifold. The number of tractors increased from 827 in 1973 to 3924 and tube-wells from 107854 in 1975-76 to 214638 in 1999-2000 in area under study. Area irrigated increased from 273202 hectare (gross irrigated area) in 1975-76 to 412719 hectare (gross irrigated) in 2000. The intensity of cropping increased to 180 percent in the district of Etah.

In general 'Green Revolution' means to increase agricultural production by introducing new technology e.g. chemical fertilizers, irrigation, high yielding variety of seeds and mechanical appliances. By introducing synthetic fertilizers and pesticides along with massive machinery to roam endless plots denuded of trees they ensured a long-lasting flow of income for decades to come. By way of money used to advertise and influence govt. agencies, politicians and universities, industry dictated not only that we needed it, but that we wanted it as well. Not for below its thinly disguised benevolence, so called 'revaluation', was only a way for industry to make a buck without regard to humanity's long term well being.

While there can be no argument that the 'Green Revolution' created a major increases in shear quantity, it has been a major

disaster for land degradation ~~efficiency~~, quality of life, productivity and the environment. Today monoculture farming is in practice. This is founded on ~~highly flawed logic~~ massive plots of thousands of acres planted with one highly inbred crop that is drowned in highly toxic chemicals and managed by behemoth machinery. Small traditional farmers around the world are being driven into bankruptcy. The green revolution has resulted in farmers planting fewer varieties of crops ~~that grow more so that they can~~ focus on use of high yielding varieties, consequently the coarse grain and pulses crops have been neglected in India in general and in district Etah particularly. The green revolution depended for its success on heavy inputs (HYV seeds, chemical, fertilizers and mechanical appliances) and ecological degradation, which leads to a variety of problems.

PROBLEMS OF LABOUR DISPLACEMENT:

Very few studies are available to assess the impact of the mechanization introduced under the garb of green revolution in term of displacement of labour. Uma K. Srivastava, Robert W. Crown and Earl O.Heady have examined the effect of two types of technological innovations introduce under the green revolution (i) biological and (ii) mechanical. The term biological innovation refers to the changes in inputs that increase the productivity of land. The introduction of high yielding varieties of seeds and use of fertilizers, fall in this category. In this sense, 'green revolution' is described as transformation of seed-fertilizer-technology. The mechanical innovations refer to the introduction of new appliances, which displace the human, or bullock labour. It is therefore appropriate to describe the green revolution as biological-mechanical revolution. It is the net effect of labor absorbing and labour-saving innovations, which well determined the extent to which mechanization need be, introduced to check further displacement of labour. "Since mechanization may dampen the

increase in labor demand, resulting from the expanding factor of seed-fertilizers, the policies that encourage premature mechanization in surplus labor economies, such as India's , do not seem conducive to solving the problem of growing unemployment" [1].

As it is well known that green revolution means the mechanization of farm, which displace a huge numbers of man labor. It is assumed, that about 55 percent of the total labor displacement is caused by tractors and pump-sets and 37 percent by thresher and reapers. Due to the mechanization of agriculture in the district Etah, a decrease in the agricultural labor has been recorded during the period of 1975-76 to 2000. In 1975, the agricultural labor constitutes 12.38 percent of the total labour force in the district and in 2000 it decreases to 11.33 percent of the total labour force.

The highest displacement of the agricultural labor is noted in the development block of Aliganj. Where the agricultural labor was 12.65 percent of the total labour in the block 1975 and 7.5 percent in 2000, in Patiali 11.7 percent in 1975 and 8.5 percent in 2000, in Sahawar 12.11 percent in 1975, 10.8 percent in 2000, in Marehra 16.5 percent in 1975 and 14.93 percent in 2000 and in Sakeet 10.58 percent in 1975 and 9.6 percent in 2000 (table-5.1).

The net employment of highly efficient mechanical appliances may turn out to be negative when mechanization of farm operations is complete. A harvest would displace farm labor on a large scale while its land augmenting effect would be negligible.

Table-5.1

DISPLACEMENT OF AGRICULTURAL LABOUR IN DISTRICT ETAH

Development Block	Agricultural Labor Percentage of Total Labor* 1975-76	Agricultural Labor Percentage to Total* Labor 2000
Marehra	16.5	14.99
Nidhauli Kalan	13.65	11.12
Sheetal pur	13.13	11.1
Sakeet	10.58	9.6
Sahawar	12.11	10.87
Sirpura	11.51	10.9
Kasganj	14.05	1.9
Amanpur	11.04	11.6
Soron	10.09	12.13
Aliganj	12.65	7.5
Ganj Dundwara	9.64	8.6
Jaithra	6.17	6.00
Patiali	11.79	8.57
Jaleasr	19.97	20.7
Awagarh	25.3	25.00

Source – District Statistical handbook 1975-2000

* absolute numbers are also required!

INCREASE IN INTER-PERSONAL INEQUALITIES:

Green revolution has increased the inter-personal inequalities. A large part of the benefits has gone to privileged section of rich farmers who were in a position to afford the new strategy which is a package program involving the use of high-yielding varieties of seeds in combination with other inputs like irrigation, fertilizers, pesticides, insecticides and improved implements. The new technology calls for a substantial investment which ~~are~~ is generally beyond the means of majority of this country's (of district Etah in particular) small and marginal farmers. It has been noted that under traditional agriculture the small farmers were not much at a disadvantage since productivity per acre was more on small farms. The adaptation of the new capital-intensive technology has shifted the advantage of productivity per hectare in favour of big farmers. As oppose to small farmers, capital is more easily available to the large farmers and they can make a more judicious use of it on account of favourable farm size. Investment in agricultural machinery can be cited as an example. Besides, the large farmers have greater risk-bearing capacity and thus, are in a better position to exploit new opportunities. It seems that small farmers are at a distinict disadvantage as compared to large farmers in the adoption of new strategy.

Table-5.2

NUMBER AND AREA OF OPERATIONAL HOLDING IN ETAH

Block	Marginal holdings (below 1 hact.)				Small holdings (1 to 4 hact.)				Medium holdings (4 to 10 hect.)				Large holdings (Above 10 hact.)			
	1975		2000		1975		2000		1975		2000		1975		2000	
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
Soron	9368	4286 (24.6)	18365	7919(30)	5114	9245 (53.1)	8912	3715 (51.86)	561	3133 (17.99)	720	4453 (16.8)	46	745	22	354
Kasgang	12353	5127 (25.1)	11412	5152(30)	5913	10934(53.54)	4988	9363 (56.2)	693	3843 (18.82)	205	1717 (10.3)	39	514	29	416
Amanpur	1239	5033 (26.43)	10808	4662(30.6)	5512	10336(54.28)	4571	7637 (50.2)	607	3294 (17.29)	435	2616	29	368	19	279
Sahawar	12362	5151(27.17)	11162	4841(30.6)	5517	10100(53.29)	4808	8749 (55.46)	562	3055 (16.11)	349	1805 (11.4)	43	649	24	378
G. Dundwara	N.A	N.A	13937	10136(29.6)	N.A	N.A	8854	15557 (45.5)	N.A	N.A	1201	8207 (24)	N.A	N.A	20	286
Patiali	N.A	N.A	13638	5846(30.5)	N.A	N.A	5710	9942(51.90)	N.A	N.A	550	3010 (15.7)	N.A	N.A	23	363
Sirpura	13753	5537 (29.2)	10513	4537(30.8)	5509	11153(58.8)	6543	7289 (49.6)	533	2914(15..38)	590	2492 (16.9)	29	340	25	379
Jalesar	5895	1797(7.8)	13290	5977(27.8)	5388	11248(448.8)	7866	11568 (53.9)	1388	8391 (36.43)	579	3515 (16.4)	119	1596	28	383
Awagarh	7259	3098 (16.66)	11810	5393(24.7)	4988	9616 (51.7)	5492	8290 (38)	916	5148 (27.6)	601	3842 (17.7)	66	733	28	389
Marehra	9203	3583(23.79)	11295	4609(29)	4305	7914 (52.5)	9891	7935 (50.2)	534	2928 (19.44)	591	287 (1.8)	44	623	28	380
N..kalan	14631	5502 (25.22)	15541	6420(29.5)	6434	11562 (53)	6957	12928(59.25)	731	4146 (19)	304	2055 (9.4)	61	631	29	413
Sheetalpur	14039	5520 (24.9)	16963	7038(29.5)	6498	11860(53.5)	7368	12937 (54.2)	728	4061 (18.33)	572	3448 (14.4)	54	712	37	433
Sakeet	16785	6216 (26.9)	17763	7391(29)	7271	12897(55.9)	7551	13377 (53)	697	3288 (14.26)	788	4231 (16.7)	34	451	25	324 1.2
Jaithra	N.A	N A	23543	7035(32.99)	N.A	N.A	6181	9898 (46.4)	N.A	N.A	582	3974 (18.6)	N.A	N.A	29	414
Aliganj	N.A	N.A	22704	6863(33.1)	N.A	N.A	2975	9303 (44.8)	N.A	N.A	703	4129 (19.9)	N.A	N.A	37	434

Note- figure in brackets are percentage of total land holding

Source- district statistical hand book –Etah –19975-2000

The study of the distribution of land holding in the district Etah shows that there are majority of small or marginal farmers. About 80 percent area (30.8% of area under marginal land holding and 42.6% under small land holding-table 5.2) is under marginal and small holding in the block of Sirpura in 2000, in Soron 30% marginal land holding 51.8 % small land holding in 200, in Sahawar 30.6% marginal land holding and 55.46% small land holding 11.4 % medium land holding and only about 3% large holding in 2000 and in Kasgan 30% marginal land holding, 56.2% small land holding, 10% medium land holding and only 4% large land holding. This data shows that the distribution of land holding is in favour of small and marginal land holding while the green revolution is directly related to land holding. The green revolution in agriculture has been characterized basically by a capital intensive technology in which hybrid seeds, use of chemical fertilizers, existence or creation of assured irrigation etc., play a significant role. This heavy inputs in agriculture have harass to the small and marginal farmers. Those make the majority in the region under study.

DECREASE IN PULSE ACREAGE:

After the introduction of 'Green revolution' the case of pulses are disappointing. Total pulses' acreage has shown a negative trend at the block level in the district. From 1975 to 2000 the annual rate of growth was negative e.g. -0.88 percent. It was 13.7 percent of the gross sown area in 1975 and only 9 percent of the gross sown area in 2000.

Pea acreage has shown a significant declined after the green revolution, in 1975 it was 27536 hectare and 9430 hectare in 2000, and the gram acreage declined at a rate of 2.5 percent per annum. Gram covered 19040 hectare (4.26 percent of the gross sown area) in

1975 and 6725 hectare (1.24 percent of the gross sown area) in 2000. These long-term trends are reflected during the changes in the relative share of this pulse group.

During the period of study of the area, it is seen that the overall area under pulses ~~have been~~ declined in the green revolution period. If we examine the production of individual pulses like *moong* (green gram) and *arhar* (pigeon pea) they indicates significant positive growth trend during the period (1975-2000). Peas and gram recorded a significant negative trend in production because the green revolution initiated ~~by the~~ a new strategy which is limited to wheat, maize and *bajra* only. Agricultural research has not been directed to the development of new seeds in major cash crops. In addition to all this, pulses, which account for about 9 percent of the total food production, have not registered any increase in acreage. If we examine the block wise distribution of pulse acreage, table-5.3 shows the acreage under pulses significantly decreasing. The acreage of peas in the Awagarh was 1180 hectare in 1975, 930 hectare in 1980, 1801 hectare in 1985, 296 hectare in 1990, 274 hectare in 1995 and 129 hectare in

Table-5.3

DECREASE IN PULSE ACREAGE Percentage

Blocks	Percentage to Gross sown area 1975-76	Percentage to Gross sown area 1999-2000
Soron	11.44	4.27
Kasganj	23.90	12.8
Amanpur	21.04	12.1
Sahawar	14.31	7.0
G. Dundwara	6.5	3.8
Patiali	10.73	4.78
Sirpura	19.28	11.75
Jaleasr	10.65	7.64
Awagarh	15.87	12.23
Marehra	21.91	17.86
Nidhauli Kalan	11.10	8.38
Sheetalpur	14.87	15.8
Sakeet	8.344	9.22
Jaithra	11.5	7.16
Aliganj	6.66	4.02

Source-District Statistical Magazine

2000. The position of acreage under pea in all the blocks is the same, i.e. decreasing trend. Green gram acreage being a *zaid* crop has been fluctuating throughout the period under review. This problem of decreasing acreage under the pulses has arised due to not properly

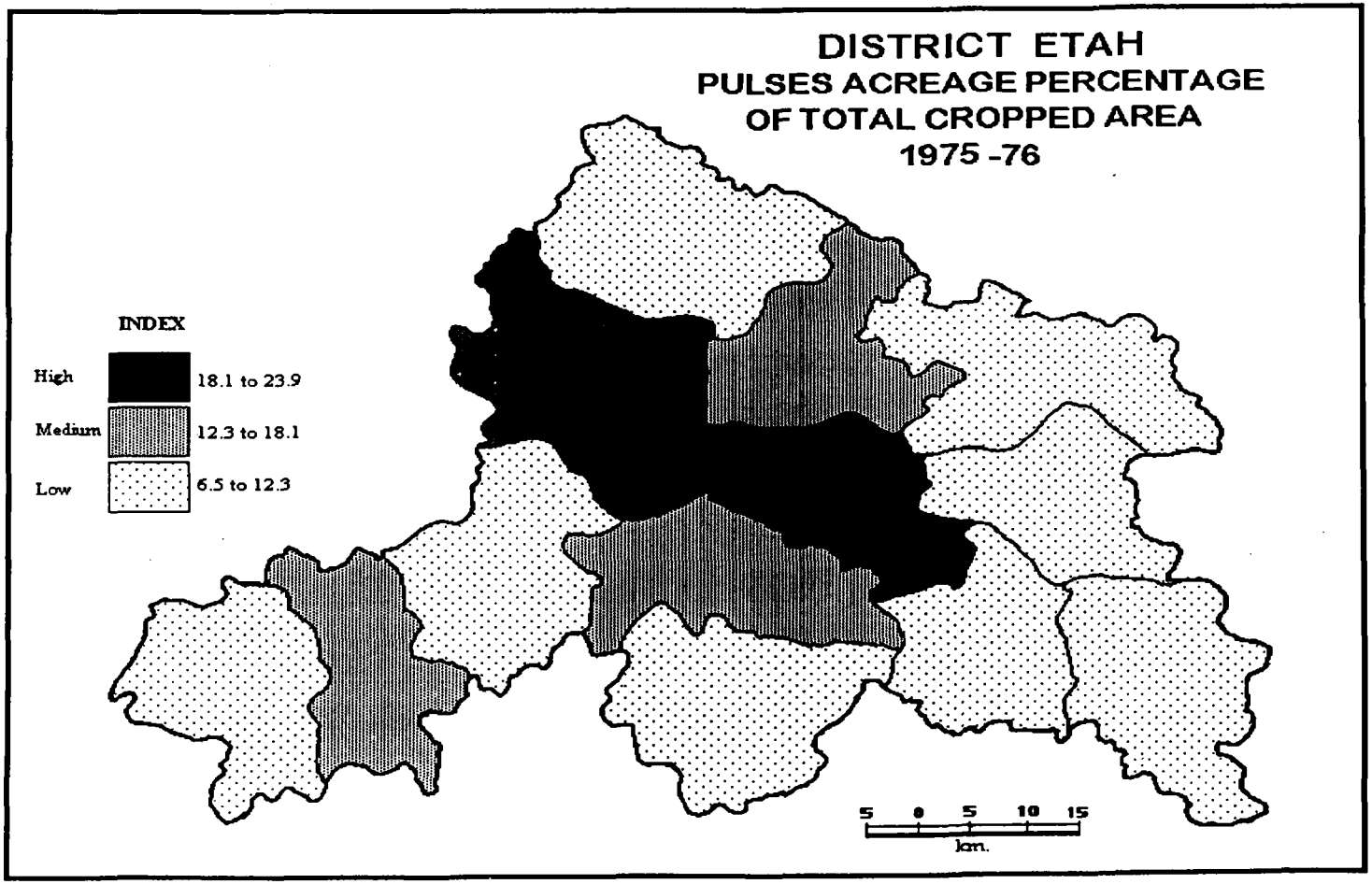

DISTRICT ETAH
PULSES ACREAGE PERCENTAGE
OF TOTAL CROPPED AREA
1975 -76
INDEX
High
18.1 to 23.9
Medium
12.3 to 18.1
Low
6.5 to 12.3
5 0 5 10 15
km.

Fig - 5.1

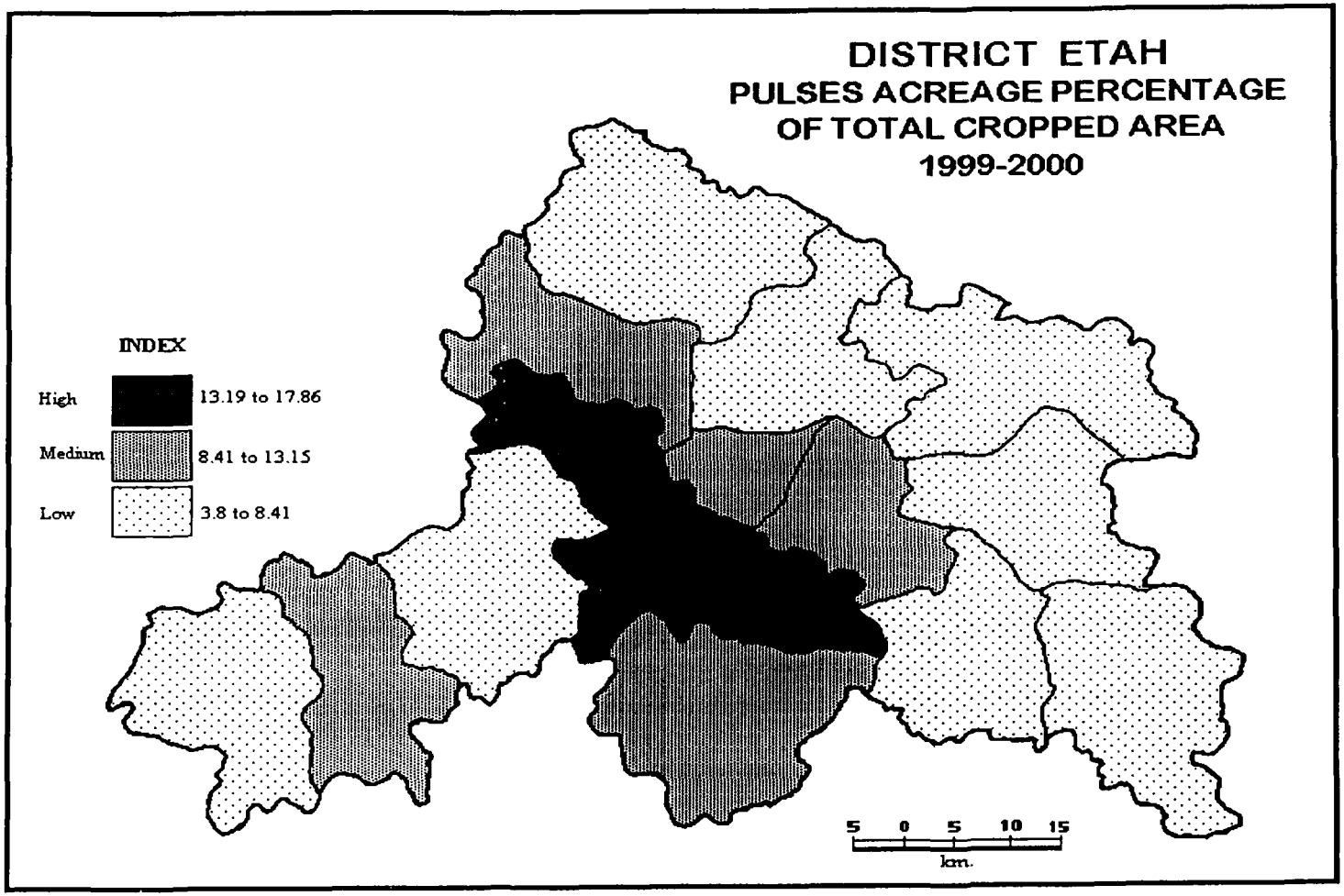

DISTRICT ETAH
PULSES ACREAGE PERCENTAGE
OF TOTAL CROPPED AREA
1999-2000
INDEX
High
13.19 to 17.86
Medium
8.41 to 13.15
Low
3.8 to 8.41
5 0 5 10 15
km.

Fig – 5.2

Table-5.4

BLOCK WISE ACREAGE OF PULSES IN DISTRICT ETAH

(IN HECTARE)

BLOCKS	Peas						Gram						Arhar						Moong					
	1975	1980	1985	1990	1995	2000	1975	1980	1985	1990	1995	2000	1975	1980	1985	1990	1995	2000	1975	1980	1985	1990	1995	2000
Soron	2050	1688	475	1342	1244	662	...	485	1008	1012	570	176	500	502	366	453	450	413	....	1569	2554	2087	2540	535
Kasganj	5007	4167	282	3310	3071	1242	....	428	479	739	270	263	402	432	602	688	680	766	.....	3286	3611	3270	3593	1755
Amanpur	4200	3463	1291	2241	2078	517	...	408	613	759	346	162	301	309	272	226	230	426	.....	1723	2726	2096	2711	2697
Sahawar	1975	1622	3514	1501	1392	338	...	339	672	714	380	115	320	319	146	236	240	237	..	898	1209	900	1203	1869
Ganjdundwara	330	270	149	470	436	321	...	680	957	1325	541	300	335	347	149	210	200	65	....	158	212	153	210	142
Patiali	837	688	570	412	382	245	....	639	1440	1171	814	354	780	789	257	252	280	45	....	420	1489	200	1481	574
Sirpura	2590	2126	201	844	782	517	....	635	644	893	364	198	430	314	192	272	270	187	...	1340	402	571	399	2187
Jalesar	1440	1179	1103	270	250	161	....	1134	1215	962	687	497	322	235	407	714	720	686	...	937	1650	1310	1644	1158
Awagarh	1130	930	1801	296	274	129	...	1409	994	723	562	499	311	226	254	687	680	625	.....	1351	2295	1953	2283	2681
Marehra	2199	1806	1660	1609	1492	1758	....	597	684	1012	386	646	455	330	676	707	778	830	.....	2881	2896	2083	2880	1874
Nidhaulikalan	611	502	194	230	213	346	....	1067	1746	908	987	726	360	255	444	550	550	550	.....	1422	1816	1299	1806	1324
Sheetalpur	2320	1910	1112	653	605	1521	....	1017	1229	1086	695	939	890	637	663	880	875	874	.....	2171	2360	3089	2347	2168
Saket	455	374	166	336	311	413	...	1183	1008	1140	569	758	401	291	302	332	335	475	.....	544	829	1178	824	1768
Jaithra	1580	1380	908	814	755	945	....	1124	1610	1988	910	422	1122	821	434	478	472	515	....	486	446	452	443	672
Aliganj	6117	507	325	197	182	315	....	383	1064	1180	601	335	811	665	422	479	480	620	.....	183	264	222	262	175

Source-District Statistical Magazine-1975, 1980,1985,1990,1995 and 2000

... - Data is not available

attention was given to the pulses during the green revolution period. That is why the green revolution was called Grain revolution.

The production does not show a clear decline !

Table-5.5

PRODUCTION OF PULSES IN DISTRICT EATH

(In quintals)

Pulses	1980	1990	2000	
Peas	195400	201610	187090	↓
Green Gram	74500	125590	84330	~
Pigeon Pea	42260	69500	48460	~
Lentils	3660	7710	13610	↑
Block Gram	1770	5070	8200	↑

Source-District Statistical Magazine, 1980, 1990 and 2000

Σ ~ 317590 Σ ~ 409480 Σ ~ 341690

PROBLEMS OF CROP DIVERSITY:

The crop diversity data of the district is not available but in general the green revolution has resulted in farmers planting fewer varieties of the crops that they grow so that they can focus on use of high yielding varieties .In addition, the varieties that are planted have been bred to a high degree of genetic uniformity within each variety. Both of these approaches are a change from past practices, in which farmers planted a large numbers of different often locally adapted, varieties, each of which generally contained a large number of different genotypes.

Thus the green revolution results in losses of genetic diversity over both the short and the long term. (Here I'm using "genetic

diversity" simply to refer to the number of different genotypes in a variety or area)

For example in India farmers have planted 30,000 different varieties of rice over the past 50 years, with the varieties grown in a region closely matched to its soils, climate and so forth. With the advent of green revolution varieties, ~~have~~ changed previous trend. It is now predicted that 75% of all rice fields in India will be planted to just 10 varieties by 2005!

Similar trends are found in most regions of the world in which the green revolution has been adopted. Seventy one percent of US corn acreage in 1991 was planted to just six varieties, while nine varieties of wheat occupy half of all the wheat land in the US. Genetic diversity of livestock has been similarly diminished over recent decades[5].

Plant responses to many stresses, both biotic (such as pathogens or pests) and ~~a~~ biotic (such as drought or temperature extremes) are at least partly under genetic control. Thus, flexibility in response to these stresses is increased when there is relatively more genetic diversity present at the population or landscape levels. Greater flexibility means greater stability in production, as entire fields (or crops, at the landscape level) are less likely to be weakened or eliminated by pests, pathogens or extremes of climate. When a new crop variety is released, it is usually resistant to most of the dominant current diseases. This is, of course, part of the plant breeder's strategy, as disease resistance is an important, usually genetically controlled, trait.

There were problems in India, with epidemics in new green revolution varieties of wheat; yields have been reduced by as much as 85% in some years. Such tremendous loses were virtually unheard of when growers were still been planting out the traditional hundreds of

locally adopted verities. Overall, year-to-year fluctuations in yields have generally been much greater since the introduction of green revolution verities; they are not as well buffered by genetic diversity against disease and climate problems. Thus, while the traditional verities were not as high yielding as the green revolution verities, yields from the traditional verities were more reliable, as they were less vulnerable to being eliminated by a pathogen or climatic anomaly. The traditional verities were not as high yielding, but were more reliable – not as vulnerable to all being wiped out by a pathogen or a climatic anomaly. In summary, with advent of the green revolution, food supplies have actually become more volatile, as large proportions of a crop fail or do very well uniformly.

We are in danger of losing the genetic diversity housed in the old verities. This diversity could turn out to be very important, for example under conditions of changed climate. Some efforts are being made to preserve them. Their seed is being kept in cold storage, or small plots of them are planted out to maintain them. However, the attempts are unlikely to be successful, unless funding for preservation of old verities increases. (It is expensive to keep seed in cold storage, to maintain records of when each variety should be taken out from storage and planted out to generate new seed (seed doesn't last forever in cold storage and must be replanted periodically to produce fresh seed), and to do the necessary planting and harvesting.) This loss of crop diversity is a crucial, but often ignored, part of the "biodiversity crisis."

ENVIRONMENTAL DEGRADATION:

Environmental degradation is a complex problem, which is being increased, faced with the passage of time. It has, in fact, reached an alarming stage at the turn of this century. When unsustainable agricultural development practices have been adopted across the

country, of course at a differential level deforestation either for the sake of fuel, fodder timber, or for the expansion of agricultural land or both and unscientific doses of chemical fertilizers without understanding the actual requirement of soil; ~~irrigation~~ use of irrigation water with mismanaged canals, extraction of underground water of the upper aquifer instead of from the deep lower aquifer through tube-wells especially for irrigation purposes; ~~over~~ cultivation without proper rotation of crops; and over grazing of animals without understanding the potentiality of the pasture and grazing lands, have resulted in ~~to~~ severe environmental degradation specially ~~the~~ land degradation. All of us feel and experience deterioration in environmental condition after the introduction of green revolution, but selection of meaningful precise indicators and to quantify them is a difficult task, ~~if not impossible~~. In the present research work percentage decrease in forest cover, percentage decrease in pasture lands sinking of water table and soil erosion (the data of soil erosion about the area under study is not available so it is not included in the indices, only theoretically have explained the problem of soil erosion) in 2000 over 1975 have taken in to account. On the basis of a judicious scoring scheme, one score has been given for one percentage change and for one foot sinking of ground water table separately.

As the district is one of the most "green revolution" adopted districts in the state of Utter Pradesh; it has almost all the problems such as environmental degradation, its varying level and intensity. The decline in forest area cover is in all the blocks and it is very much in accordance with the national scenario. It ranges from 3.3 percent decrease per year to 0.14 percent per year. The basic reason is the cutting of the forest for the expansion of agricultural land due to the mechanization of agriculture. Moreover it also provides the fodder and fuel to the people. Due to the excessive cultivation and heavy doses of

chemical fertilizers to support the high yielding verities of seeds, agricultural land has deteriorated and has become unfit for cultivation, but it is compensated by bringing forest area under cultivation. The maximum loss is in Sahawar followed by Amanpur and Soron blocks. A comparative look at the percentage loss in area strength in forest and net area sown indicates that they are in the same proportion and order. As the agricultural land has degraded due to the massive induction of agricultural technology especially chemical fertilizers, irrigation water, farm implements, the cultivators have no option except to abandon that land or leave it fallow for one or two years depending upon the degree of deterioration.

Soil erosion in general is one of the crucial problems of Indian agriculture but it is more so in agriculturally developed region due to excessive cultivation which makes the soil lose and more susceptible to erosion. The percentage increase in soil-eroded area is not very alarming. The excessive doses of irrigation, mismanagement of flow of water in the canals has ~~leads~~ led to the massive underground percolation of water. Consequently, water table has come up near the surface leading to low capacity ~~further~~ for absorption of water, which has resulted in to problem of water-logging. The irrigation water either from canals or tube-wells which accumulates in shallow depressions or even the rain water accumulating in low lying areas remain on the surface and create the problem of water logging. Some times the brackish water comes near the surface and consequently with capillary action a thick layer of salt is deposited on the surface leaving the land saline and alkaline. There is sharp contrast in this problem of environmental degradation among various blocks of this district.

Semi-arid conditions coupled with unscientific high doses of irrigation water leads to the problem of salinity and alkalinity, which is mainly the outcome of the capillary action. Besides this, irrational high

doses of chemical fertilizers also result into salinity and alkalinity especially when it is not supplemented with 'farmyard manure'. The district when on the one hand is facing the problem of water logging in many blocks, while on the other hand; the water table is also sinking in some blocks. This is mainly due to extraction of water through the tube-well from the upper aquifers. Consequently, water table sinks so much, so that it not only creates the problem of lifting water through tube-wells, but also results in the shortage of drinking water. The sinking of water table ranges from 0.26 foot in Soron to 1.7 in feet in case of Jalesar followed by Jaithra where it is 1.4 feet.

GREEN REVOLUTION AND LEVELS OF ENVIRONMENTAL DEGRADATION:

The above discussion gives the status of environmental degradation at block regarding the four selected indicators. But in order to get a comprehensive and composite picture of environmental degradation in each block, a composite index of environmental degradation has been worked out for them by adding the value of individual indicators and dividing it with total number of indicators (table-5.7). Based on these indices of each block, the level of environmental degradation has been worked out by grouping them into three categories e.g. high, medium and low (fig5.3).

REGIONS OF HIGH ENVIRONMENTAL DEGRADATION:

During the study some of the blocks are identified as high level of environmental degradation in the district due to the introduction of green revolution. It is namely; Amanpur, Sahawar, Ganjdundwara and Aliganj, with a composite index of 1.525, 1.34, 1.38 and 1.6 respectively.

Table-5.6

INDICES OF ENVIRONMENTAL DEGRADATION

(1975-2000)

Blocks	Forest area	Posture Land	Fallow Land	Sinking of Water table	Composite Index
Soron	0	0	0.6	0.26	0.215
Kasganj	2.8	0	0.2	0.8	0.95
Amanpur	3.3	2.6	0.2	N.A.	1.525
Sahawar	3.2	0.14	0.73	1.3	1.34
Ganjdundwara	0.78	3.8	0.15	0.8	1.38
Patiali	2.06	2.64	0.15	0.9	1.43
Sirpura	1.53	1.65	0.9	N.A.	1.00
Jalesar	N.A.	0.55	0.13	0.9	0.39
Awagarh	0.83	0.33	0.26	0.84	0.56
Marehra	0.64	3.09	0.033	1.7	1.36
Nidhauli kalam	3.22	1.72	0.13	1.00	1.5
Sheetalpur	0.14	1.67	0.06	0.9	0.69
Sakeet	1.44	0.88	0.22	1.01	0.88
Jaithra	2.86	N.A.	0.27	1.4	1.13
Aliganj	1.94	2.44	0.20	1.9	1.6
Etah district	1.64	1.43	0.28	0.9	1.06

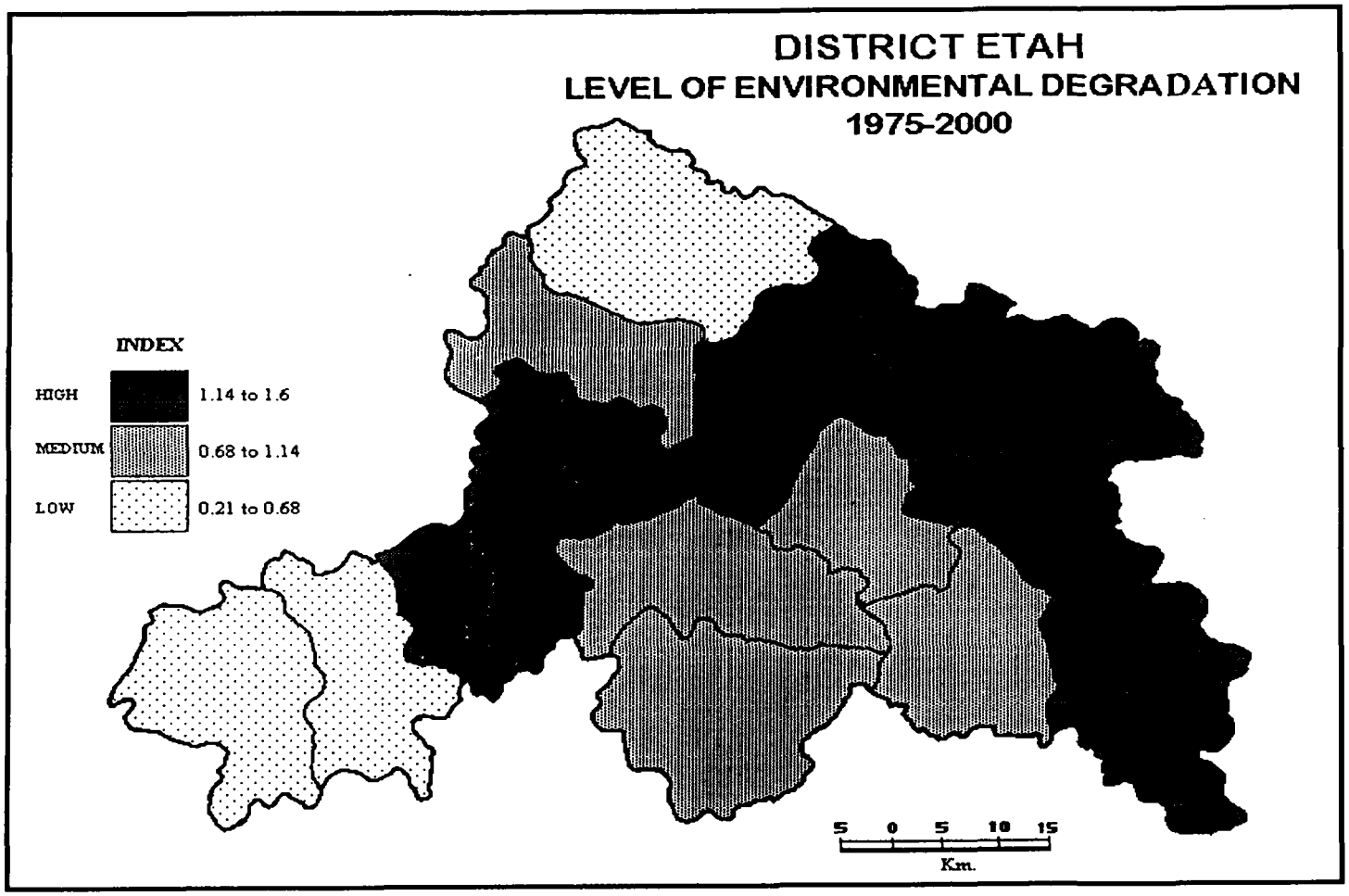

DISTRICT ETAH
LEVEL OF ENVIRONMENTAL DEGRADATION
1975-2000
INDEX
HIGH
1.14 to 1.6
MEDIUM
0.68 to 1.14
LOW
0.21 to 0.68
5 0 5 10 15
Km.

Fig - 5.

Aliganj belongs to high category of environmental degradation incase of all indicators, except fallow land. Moreover, it is also found that due to the excessive use of pasture land and water (for the purpose of irrigation). They all lead to degradation in the under ground water table, pasture land and forest of the area (Table-5.7).

REGIONS OF MEDIUM ENVIRONMENTAL DEGRADATION:

This region includes north western and southern part of the district i.e. development block of; Kasganj, Sirpura, Sheetalpur, Sakeet and Jaithra with a composite index of 0.95, 1.00, 0.06, 0.88 and 1.13 respectively. The status of these blocks is not constant in case of all selected indicators of environmental degradation but by and large they fall in the moderate categories. In the case of fallow land Sipura falls in the highest category, but in case of other indicators it comes in the medium categories. As such it has lesser degree of environmental degradation (Table-5.7).

REGIONS OF LOW ENVIRONMENTAL DEGRADATION:

This region is found in the periphery of the district or in that block the new strategy is not fully adopted or most part of the blocks is *usar* land or *kettary* or Alkaline. These blocks also have fluctuation in case of selected indicators. Soron block have lesser degree of environmental degradation, because there were no forest in the region before the induction of green revolution the most of the part of this block is *trai* type or water logged due to the vicinity of Ganga River. Jaleser & Awagarh also falls in the category of lesser environmental degradation due to the adoption of green revolution with the composite index value 0.39 and 0.56 (Table-5.7), Because most part of the block Jalesar is affected with the patches of salt affected soils due to semi-arid climatic conditions and misuse of irrigation water. These blocks

belong to the lowest level of agricultural development and hence have least problems of environmental degradation.

GREEN REVOLUTION A CAUSES NOT THE CURE:

The above analysis of the "Green Revolution" in a complete view, one must admit that it is the cause of the problem, not the cure. Adding genetic engineering further complicates the life of pesticides rather than ending them. But unlike the brutally toxic legacy of pesticides, which have only killed and injured people and animals, poisoned water, air and soil, caused part of global warming, caused the bankruptcy of many thousands of farmers, some of whom have committed suicide.

Refrence:

1 Srivastava,U. et. al. (1971), 'Green Revolution and Farm Income Distribution' *Economic and Political Weekly*, Dec. 25.

2 Sani, G.R., (1976), 'Green Revolution and Distribution of Farm Income' *Economic and Political Weekly*, March 27, pp A17 to A22.

3 Bardhan, P., (1970) 'Green Revolution and Agricultural Labourers' *Economic and Political Weekly*, July.

4 Bhalla, G.S. and Chadha, G.K., (1982) 'Green Revolution and Small Peasent' *Economic and Political Weekly*, May 15 and 22.

5 Lovejoy, Thomas, et. al., (1999) 'Green Revolution' Dispatch August 22, www. gogly.com.

6 Mohmmad, Noor, (1997) 'Agricultural Development and Environmental Degradation in Sonipat Distrct, Haryana' *National Geographical Journal of India*, Vol. 43, No. 3, pp 198-208.

Chapter - 6

The Place of Coarse Grain in the Cropping Pattern

THE PLACE OF COARSE GRAIN IN THE CROPPING PATTERN

The case of coarse grains (pearl millets, sorghum, barley etc.) is disappointing in the cropping pattern during the period of green revolution or post green revolution. Varietal improvements though not completely bypassed, have nevertheless been less sustainable. For example, in 1985-86 area under HYVs was 58 percent of rice, 85 percent of wheat, but only 31 percent of sorghum, 43 percent of pearl millet and 38 percent of maize (Economic Survey 1986). HYVs can yield three to seven times more than traditional varieties but most of them are location specific and are susceptible to pests and diseases. Low rate of profit, low value status and restricted demand as they are produced and eaten by poor people restricted their absorption capacity for yield-enhancing high cost inputs like chemical fertilizers[1]. Any large-scale improvement in productivity or production due to good weather may generate a glut in the market. They are faced with competition from superior cereals like rice and wheat, which in some areas are available at prices lower than that of coarse cereals. The technological advancement, govt. policies and the features described earlier contributed to this. Raising the productivity of these crops through judicious fertilizer use is crucial to sustain yield-based growth in agricultural production, as the area under coarse grain crops is substantial in district Etah.

The important coarse grain crops in the region under study are pearl millets, barley and sorghum. The coarse grains (pearl millets, barley and sorghum) occupied 31.9 percent area to the gross cropped

area in Etah during 1999-2000. Pearl millet is the second coarse food grain crop of the district after wheat and contributes to the staple food of the people.

The rational allocation of land ~~among~~ to different crops is a matter of crucial importance both from the point of view of increasing income of the farmer and increasing agricultural production of the country. With the introduction of high yielding and short duration varieties of crops, the study of a particular crop in the cropping patterns has assumed ~~a~~ special significance in shaping the agricultural production programs in the area under study. The single most important element in the cropping pattern strategy in the post green revolution period is improved agricultural technology consisting of high yielding plant varieties intensive cultivation, greater use of fertilizers, increased irrigation and better techniques for planting, harvesting and plant protection.

Stagnation or very slow growth of coarse grain cultivation during the period under study has become a serious concern of planners and policy makers in India. Dependency on rainfall, lack of new technology, poverty of farmers and ~~the~~ absence of infrastructural support are often cited reasons for the slow growth of these crops. Nevertheless, the poor performance of these crops at the macro level is the result of farmer's decision and their actions. The following study illustrates the place of coarse grain in the existing cropping pattern and trend from 1975 to 2000 in the various blocks of the district Etah.

Hence an attempt has been made to assess regional variations and level of growth of coarse grain cultivation in changing cropping pattern during 1975 to 2000. In order to make the data comparable, the percentage of individual crops to the gross sown area has been arranged in tabulated form. An emphasis has been attached to ~~given on~~ the analysis of the place of coarse grain during 1975 to 2000 in various

blocks. The practices adopted have been examined in terms of quantitative analysis per unit of gross cropped area to see its impact on changing cropping pattern

PATTERN OF COARSE GRAIN CROPS:

New agricultural strategy refers to the development of high yielding varieties of seeds, ~~which~~ supported by chemical fertilizers, irrigations facilities and mechanical appliances. This new strategy ~~is~~ successfully implemented in a few superior grain crops e.g. wheat and rice. While the other crops (coarse grain crops-pearl, millets, barley and sorghum) ~~are~~ ignored ~~either~~ less affected by the green revolution or ignored by the farmers to adopt.

PEARL MILLETS:

Pearl millet is an important ~~smaller millet~~ crops. It is generally grown under marginal conditions of moisture and soil fertility and the yield per hectare is consequently very low. Pearl millet is a poor man's crops. It is most ~~drought~~ tolerant among cereals and millets. Pearl millet is very important crop of dry farming and the grains are used for the preparation of ~~bread~~. It is also used as a forage crops for the cattle.

Pearl millet is a second important crop of the district Etah next to wheat. It covers 14.14 percent of the gross sown area in 2000 and 19.64 percent in 1975. While the wheat ~~have~~ 36.20 percent of the gross sown area in 2000 and 32.47 percent in 1975. Pearl millet is second food grain crop of the district but the acreage under this crop decreasing continuously i.e. from 87695 hectare in 1975 to 76051 hectare in 2000. It shows a declining rate of 0.53 percent per annum.

The figure and table-6.1 shows general distribution of pearl millet crop in various development blocks of the district Etah during the period of 1975 to 2000. Development block Jaithra has highest

acreage under the pearl millet i.e. 9454 hectares or 27.9 percent of its gross sown area in 1975 and 8111 hectare or 20.25 percent of its gross sown area in 2000 (Table-6.1). Block Kasganj have second rank in the pearl millet acreage i.e. 9156 hectare or 25.9 percent of its gross sown area in 1975, 9638 hectare or 26.87 percent in 1980, 8006 hectare or 21.6 percent in 1985, 6804 hectare or 18.31 percent in 1990, 7008 hectare or 18.5 percent in 1995 and 6805 hectare or 20.2 percent of its gross sown area in 2000 (Table-6.1). Block Jalesar has third position in the acreage of pearl millet and followed by Soron, Amanpur, sahawar and Marehra. The development block of Sakeet have lowest acreage under the crop of pearl millets, it is also third rank crop of this block after wheat and maize. In development block of Sakeet, pearl millets covered 3265 hectare or 10.39 percent of its gross sown area in 1975, 3434 hectare or 11.3 percent in 1986, 3216 hectare or 10.5 percent in 1985, 2520 hectare or 7.21 percent in 1990, 2595 hectare or 6.5 percent in 1995 and 3505 hectare or 9.1 percent in 2000 (Table-6.1). These fluctuations in the acreage of pearl millets crop are due to the fluctuation in the monsoon and crop substitution factors.

Table 6.1

BLOCK WISE PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA IN DISTRICT ETAH

SAKEET

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	39.5	13.4	8.5	3.26	3.9	8.3	10.99	12.15
1980	40.4	13.08	10.7	NA	4.55	8.19	11.3	11.78
1985	41.4	12.9	10.4	3.8	5	7.8	10.5	8.2
1990	46.13	9.34	12.6	4.26	5.6	8.9	7.21	5.96
1995	37	8.75	12.5	4.97	4	8.4	6.55	17.83
2000	39.4	10.5	13.8	4.93	3.6	9.22	9.12	9.43

AMANPUR

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	26.36	13.93	4.7	3.28	2.23	21.04	22.6	5.86
1980	26.9	13.64	6	N.A.	2.72	20.6	23.4	6.74
1985	28.93	9.34	5.6	3.77	2.73	17.17	20	12.46
1990	30.35	11.53	6	3.65	3.19	18.8	16.63	9.85
1995	33.6	11.4	11.58	4.48	2.39	13	15.95	7.6
2000	34.7	11.35	11.6	4.02	3	12.1	11.78	11.45

JAITHRA

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	33.87	10.13	3.87	1.5	2	11.5	27.9	9.23
1980	34.58	8.73	4.89	N.A.	2.39	11.2	28.84	9.37
1985	39.5	8.92	6.06	1.78	3.16	10.21	21.66	8.71
1990	39.72	11.9	5.25	1.98	2.76	10.8	19.78	7.81
1995	40.75	11.76	4.85	2.43	1.36	9.3	18.95	10.6
2000	40.74	11.55	5	4.39	1.9	7.16	20.25	9.01

Table 6.1

BLOCK WISE PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA IN DISTRICT ETAH

JALESER

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	38.35	2.14	6.53	7.1	7.4	10.6	20.61	7.27
1980	39.303	2.06	8.21	0	8.7	10.43	21.1	10.197
1985	33.8	2	4.5	8.17	10.14	13	17.62	10.77
1990	40.77	11.9	4.32	6.52	8.74	9.36	16.58	1.81
1995	40.84	12.68	3.9	9.14	7.65	8	17.54	0.25
2000	39.7	2.25	4.6	8.74	6.75	7.64	18.48	11.84

ALIGANJ

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	34.1	17.12	3.08	2.67	1.14	6.6	18.8	16.49
1980	34.8	14.79	3.88	N.A.	1.3	6.54	19.44	19.25
1985	33.46	15.64	4.65	2.9	1.83	6.03	16.323	19.167
1990	35.95	15.98	3.31	2.19	1.42	6.27	14.42	20.46
1995	34.47	15.66	3.14	2.66	1.05	5.3	12.99	24.73
2000	34.53	16	3.23	3.56	0.9	4.02	14.26	23.5

AWAGARH

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	32.87	5.7	12.44	6.23	5.9	15.8	12.3	8.76
1980	33.56	5.65	15.7	N.A.	7	15.5	12.7	9.89
1985	37.55	4.53	14.51	6.51	7.6	16.8	11.18	1.32
1990	38.7	4.67	13.17	5.8	7.49	12.7	8.35	9.12
1995	38.44	4.58	13	7.11	5.6	11.5	7.68	12.09
2000	38.57	3.4	15.565	6.58	3.8	12.23	10.28	9.575

Table – 6.1

BLOCK WISE PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA IN DISTRICT ETAH

MAREHRA

YEAR	WHEAT	MAIZE	RICE	OIL SEEDES	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	30.38	11.23	3.1	2.7	3.54	21.9	19.4	7.75
1980	31.1	10.93	3.94	N.A.	4.17	21.5	20.9	7.46
1985	35.73	11.2	5.28	3.21	4.13	22.15	18.14	0.16
1990	36.37	12.2	3.987	3.99	5.33	20.1	15.7	2.323
1995	30.2	12.16	3.8	4.9	4.04	18.6	15.222	11.078
2000	30.12	13.13	4.2	6	3.64	17.8	15.18	9.93

N.KALA

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	39.13	12.16	9.36	3.5	6.3	11.1	10.4	8.05
1980	39.94	11.88	12.1	N.A.	7.5	10.9	10.8	6.88
1985	41.4	10.3	9.64	3.8	8.9	10.05	10.25	5.66
1990	41.51	10.09	1.3	3.69	6.4	11.8	9.73	15.48
1995	38.9	9.38	1.07	4.2	4.54	10.09	8.78	23.04
2000	41.26	8.5	8.89	6.84	5.77	8.38	10.98	9.38

KASGANJ

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	24.05	10.4	1.64	4.4	3.4	23.9	25.9	6.31
1980	24.54	10.25	2.08	N.A.	4	24.5	26.8	7.83
1985	32.58	11.37	1.4	5	3.5	13.8	21.6	10.75
1990	25.42	12.97	0.7	4.5	3.63	8.4	18.3	26.08
1995	29.9	13.56	0.95	5.8	2.88	8.3	18.57	20.04
2000	34.74	16.97	1	6.23	3.37	12.8	20.27	4.62

Table -6.1

BLOCK WISE PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA IN DISTRICT ETAH

SAHAWAR

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	27.1	10.5	3.7	3.7	1.4	14.3	23.1	16.2
1980	28.16	10.54	4.65	N.A.	1.5	14.36	24.46	16.33
1985	28.53	11.09	4.63	4.26	2.88	22.5	23.28	2.83
1990	28.5	13.68	4.96	3.51	2.88	13.2	9.28	23.99
1995	32.7	14.02	6.91	4.47	2.34	11.3	9.23	19.03
2000	32.85	12.26	7.9	4.56	1.86	.7	13.28	20.29

GANJDUNDWARA

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	36	8.5	4.9	4.68	3.39	6.5	17.23	18.8
1980	36.75	19.94	6.18	N.A.	4.03	6.3	17.8	9
1985	36.09	16.86	3.85	5.44	3.5	5.8	16.9	11.56
1990	36.8	11.24	4.05	4	3.12	8.9	13.49	18.4
1995	36.59	9.86	6.04	4.37	2.07	4.89	11.48	24.7
2000	38.09	11.81	6.02	6.53	2.24	3.8	14.32	17.19

PATIALI

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	32.7	8.7	5.77	2.8	1.64	10.7	19.5	18.19
1980	33.4	8.58	7.28	NA	1.86	10.5	20.9	17.48
1985	35.1	9.98	6.74	6.2	2.42	13	16.11	10.45
1990	34.8	12	4.88	6.2	3.68	8.5	12.7	17.24
1995	39.26	11.83	7.26	7.6	2.75	5.6	12.13	13.57
2000	36	9.95	6.72	5.88	1.19	4.787	14.39	21.083

Table 6.5

BLOCK WISE PERCENTAGE SHARE OF MAIN CROPS TO THE TOTAL CROPPED AREA IN DISTRICT ETAH

SIRPURA

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARLMILLETS	OTHERS
1975	33.4	10.7	8.9	2.8	2.08	19.28	21	1.84
1980	34.19	10.5	11.24	NA	2.45	18.9	21.72	1
1985	33.42	10.4	7.86	2.7	2.11	5.7	17.24	20.57
1990	32.54	15.5	4.77	4.1	3.25	10.6	13.02	16.22
1995	34.52	15.65	12.99	5.17	2.49	9.4	12.7	7.08
2000	34	11.7	12.4	3.5	1.9	11.75	11.3	13.45

SHEETALPUR

YEAR	WHEAT	MAIZE	RICE	OIL SEEDS	BARLEY	PULSES	PEARL MILLETS	OTHERS
1975	35.5	6.16	3.17	3.5	3.6	14.8	19.4	13.87
1980	36.2	8.36	4	NA	4.35	14.5	20.1	12.49
1985	36.8	10.7	4.4	3.77	4.58	14.5	15.72	9.53
1990	32.8	12.77	6.5	3.2	5.04	17.5	12.73	9.46
1995	36.04	12.13	8.74	3.78	3.64	16.3	11.74	7.63

SORON

YEAR	WHEAT	MAIZE	RICE	PEARLMILLETS	BARLEY	PULSES	OIL SEEDS	OTHERS
1975	24.6	11.76	2.07	2.13	2.4	11.44	3.97	41.63
1980	25.1	11.6	2.6	22	3	11.24	N.A.	24.46
1985	28.4	12.15	2.4	20.44	3.8	11.5	4.6	16.71
1990	31.06	15	1.6	18.46	3.4	12.2	2.59	15.69
1995	35.6	14.2	2.28	16.92	2.4	8.9	3	16.7
2000	35.6	16.2	2.2	18.23	2.25	4.27	5.4	15.85

BARLEY:

Barley is an important crop in India. Indian Barley compares well with the best Egyptian and Californian barley in molting and brewing[2]. Barley crop is grown in marginal land, which is generally considered to be unsuitable for cultivation of wheat. It is mostly grown as a rain fed crop. The irrigation is utilized mainly for raising wheat crop. Besides, it is quite uncommon with the cultivators to apply adequate quantity of fertilizers to this crop. The introduction of high yielding varieties of wheat and hybrid maize has also given a serious set back to the barley production in areas where the irrigation resources exist and which could be utilized for the better production of this crop.

Well-drained loam soils are best suited for barley. A heavy poorly drained soil produces poor crops. It is quite a hardy crop and it can be grown also under dry conditions. Barley is one of the most dependable cereals under extreme conditions of frost or drought. It is mostly grown in temperate regions. It is suited to moderate areas. The ideal conditions for growing barley is moderately dry period for sowing, occasional showers in growing season and good weather for harvesting.

In district Etah, barley is the fifth most important cereal crop after wheat, pearl millets, maize, and rice which have 16874-hectare under barley i.e. 3.03 percent of its gross sown area in 2000. The area under the barley is increasing but at a very slow rate since 1975. The total acreage of barley in 1975 was 15241 hectare that was 3.41 percent of its gross sown area.

The table 6.2 and figure 6.2 shows that the block Jalesar has highest acreage under barley crops among all the blocks of the districts. Jalesar have devoted 2522 hectare to the barley or 7.39 percent of its gross sown area in 1975, 3031 hectare or 8.7 percent in 1980 and 3584 hectare or 10.14 percent of its gross sown area in 1085. After 1985 the area under

barley began to decrease in the block and it come down to the 3161 hectare or 8.7 percent of its gross sown area in 1990, 2549 hectare or 7.65 percent in 1995 and 2388 hectare or 6.5 percent of its gross-sown area. Barley constitutes the third most important crop of the block Jalesar after the wheat and pearl millets. Nidhulikalan have the second position in the barley acreage followed by Awagarh and Marehra. The total acreage of barley in the Nidhuliklan was 1924 hectare in 1975, which was 6.35 percent of its gross sown area, 7.5 percent in 1980, and 8.9 percent in 1985. After 1985 the percentage share of the barley to the gross sown area in the Nidhuli kalan and it became 6.4 percent in 1990, 4.5 percent in 1995 and 5.7 percent of the gross sown area in 2000. These fluctuations in the block of Nidhulikalan are reported due to the percentage of other higher value crops due to the development of good means of irrigation. The development block of Awagarh have 1514 hectare or 5.9 percent barley acreage to the gross sown area in 1975 and 1264 hectare or 3.82 percent of the gross sown area in 2000.

The lowest acreage of barley ~~are~~ was recorded in the development block of Aliganj and followed by Sahawar. In Aliganj the total area under the barley crop was 387 hectare or 1.14 percent of the gross sown area in 1975 and 404 hectare or 0.9 percent of the gross sown area in 2000. The total area under barley crop has increased in the development block of Sahawar during the period of 1975-2000. But the production to the gross sown area is stagnant e.g. 330 hectare or 1.4 percent to the gross sown area in 1975 and 538 percent hectare or 1.8 percent of gross sown area in 2000. This slow or stagnant rate in the growth of the barley acreage is due to the high yielding varieties of wheat, rice and maize, low demand of the barley and adequate irrigation facilities to support the high value crops.

PULSES:

The use of pulses with cereals is a very common practice in district Etah and this practice is considered to be very scientific because of the high protein contents in the pulses, which is required for balanced food for a large population in the country dependent upon vegetarian food[3]. But the adequate attention has not been paid so far to the development of pulses as has been done in the case of wheat, rice and maize etc. so the production figure in the district remained always static, though the pattern of crops has been changing. At least some of these changes might have influenced the pattern of pulse crops despite the apparently stable production not only in district Etah but at all India level.

In district Etah, four crops of pulses – peas, gram, pigeon pea and green gram are taken for the present study. Pea is a popular pulse crop of the district Etah. It provides a variety of dishes and therefore it is liked everywhere. Peas occupied about 2 percent of the total cropped area of the district. The block-wise distribution of the pea crops shows that the area under the peas is decreasing since 1975. Peas occupied 5 percent of the total cropped area in the development block of the Soron during the period of 1975-76, 4.21 percent in 1980, 1.17 percent in 1985, and 3.1 percent in 2000 (Table-6.1). The area under the crop of peas is continuously decreasing. There is not even a single block, which shows an increasing trend in the area under the peas. The most important cause behind this decreasing is stagnation in yield out dated labour consuming harvesting technology.

Gram is also a very important pulse crop not only of the district Etah but also of India. But unlikely the area under these crops is decreasing too. The development block Awagarh have occupied 5.4 percent of its total cropped area or 1409 hectare in 1980, which was the highest acreage under the crop of gram but with the passage of time it left only 1.5 percent of its

gross sown area or 499 hectare in 2000, (it was 3.4 percent in 1985, 2.4 percent in 1990 and 1.75 percent in 1995) (fig-6.2).

Pigeon pea is one of the most widely cultivated pulse crops of district Etah, next in importance to gram. It is difficult to make very reliable estimate of the extent to which it is cultivated because it is mostly grown as mixed crop and seldom as a pure crop. But the same problem arises with the crop of pigeon pea of decreasing area under the coarse grain. Pigeon peas occupied about one percent area of the total cropped area in the district Etah. The other important pulse crop of the district Etah is green gram, which shows a fluctuation between 5 to 6 percent in the district. Green gram crop is the only crop which occupied the highest percentage of gross sown area in the district; because it is sown as a *Zaid* crop in the district, just after harvesting of wheat field. The highest green gram acreage is found in the Kasganj block e.g. 17.4 percent of gross sown area or 3286 hectare in 1980, 19.41 percent or 3611 hectare in 1990, 18.83 percent or 3593 hectare in 1995 and 9.60 percent of the gross sown area or 1755 hectare in 2000. Green gram acreage is fluctuating very little because it is *Zaid* crop and requires less input, but over all the area under the green crop is decreasing, there is only one block which shows increasing trend in green gram acreage i.e. Sheetalpur, that have 10.52 percent of its gross sown area or 2171 hectare in 1980, 11.44 percent or 2360 hectare in 1985, 14.47 percent or 3089 hectare in 1990and or 3168 hectare in 2000 (Table-6.1).

The preceding discussion portrays a rather depressing picture of the current state of coarse grain cropping pattern at the block level. In order to alter the situation factors influencing both production and demand for coarse grains need attention.

SORGHUM:

Sorghum is one of the most important cereals in India. It is cultivated as rain fed crop. The per hectare production of sorghum is very poor mainly

because it is cultivated as rain-fed crop where application of fertilizers is almost nil. Besides it is mostly grown in marginal areas that are not suitable for crops like maize and wheat. In the district Etah, this crop is used for preparation of silage and for forage. So the area under this crop is negligible i.e. 538 hectare or 0.09 percent of its gross sown area. Development block of Nidhulikalam have first position in sorghum acreage that have 140 hectares or 0.38 percent of its gross sown area which is 26.02 percent of the whole district acreage of sorghum and followed by Jalesar, Aliganj and Jaithra blocks. These blocks have 90 hectare, 90 hectare and 66 hectare respectively (Table-6.1).

YIELD TREND OF THE COARSE GRAIN IN ETAH:

In order to obtain trend lines of the production of selected crops to compare with coarse grain of the period under study. The following equation has been used:

$$Ye = a + bX$$

The trend value of the district has been plotted in figure 5.17& 5.18 which shows an easy comparison of trend in production of different crops. The above figures suggest that the production per hectare of wheat increased rapidly as compared to maize pearl millets, rice and barley. The trend of rice, maize has increased moderately pearl millets shows a slow trend in the production per hectare. The coefficient of correlation between area and yield shows a negative relationship except pearl millets. It confirms that in spite of increasing the area under different crops the volume of production is also increasing.

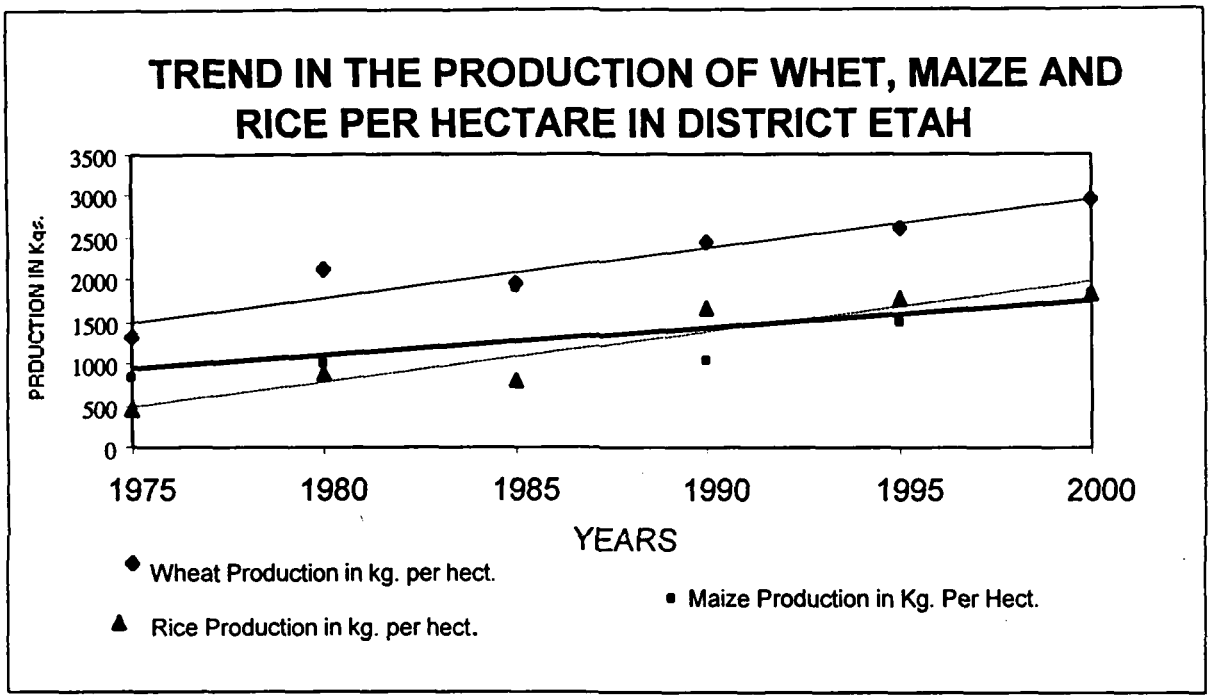

TREND IN THE PRODUCTION OF WHET, MAIZE AND RICE PER HECTARE IN DISTRICT ETAH
PRDUCTION IN Kgs.
3500
3000
2500
2000
1500
1000
500
0
1975
1980
1985
1990
1995
2000
YEARS
Wheat Production in kg. per hect.
Maize Production in Kg. Per Hect.
Rice Production in kg. per hect.

Fig.- 6.1

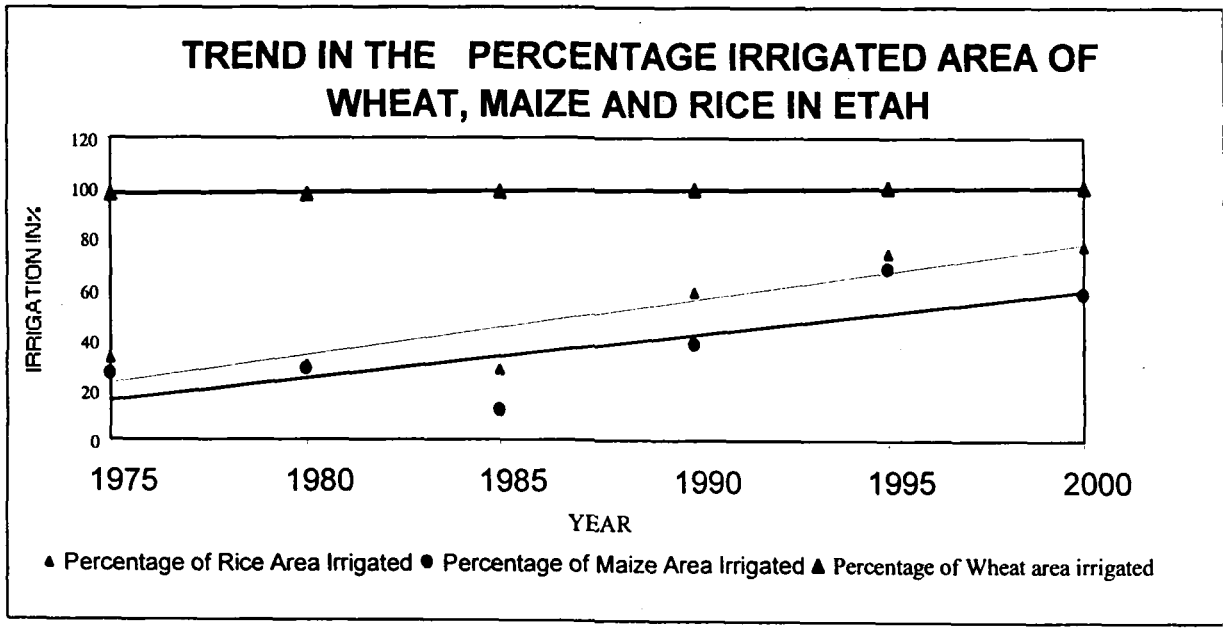

TREND IN THE PERCENTAGE IRRIGATED AREA OF WHEAT, MAIZE AND RICE IN ETAH
IRRIGATION IN%
120
100
80
60
40
20
0
1975
1980
1985
1990
1995
2000
YEAR
Percentage of Rice Area Irrigated
Percentage of Maize Area Irrigated
Percentage of Wheat area irrigated

Fig.-6.2

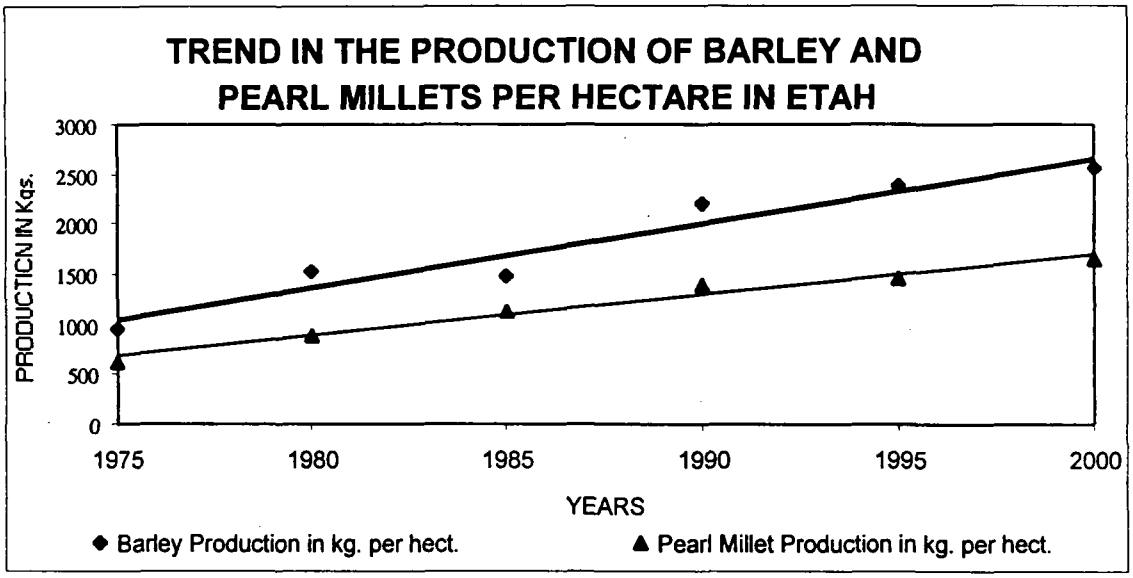

TREND IN THE PRODUCTION OF BARLEY AND PEARL MILLETS PER HECTARE IN ETAH
PRODUCTICN IN Kgs.
3000
2500
2000
1500
1000
500
0
1975
1980
1985
1990
1995
2000
YEARS
◆ Barley Production in kg. per hect.
▲ Pearl Millet Production in kg. per hect.

Fig- 6.3

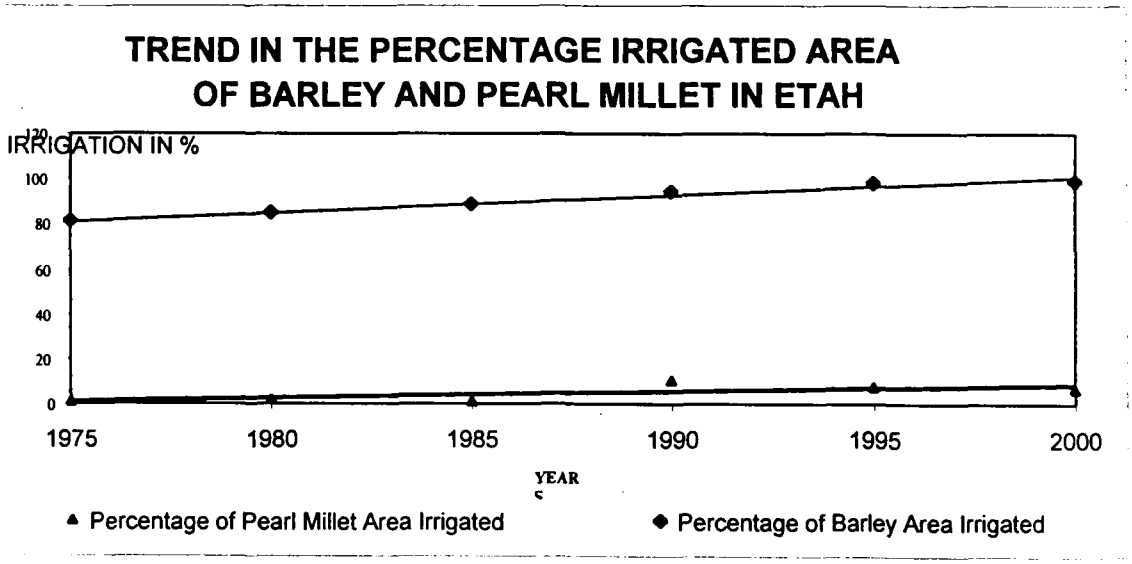

TREND IN THE PERCENTAGE IRRIGATED AREA OF BARLEY AND PEARL MILLET IN ETAH
IRRIGATION IN %
120
100
80
60
40
20
0
1975
1980
1985
1990
1995
2000
YEARS
▲ Percentage of Pearl Millet Area Irrigated
◆ Percentage of Barley Area Irrigated

Fig- 6.4

It means the yield per hectare is increasing because the availability of assured irrigation, application of chemical fertilizers and other modern appliances.

In fact the yield of the coarse grain is increasing continuously. But the low value[1] status of pearl millets, barley and sorghum is a well-known fact. However, these crops stand vis-à-vis other high value crops of the respective regions (e.g., wheat, rice millets etc.). Consequently, the farmers often allocate less labour to these crops at the farm, village and regional levels. Small and medium farmers left their coarse grain crops uncared for working on irrigated farms to improve economic conditions.

The capacity of new technology to compensate for the low value status of coarse grains may be limited unless sustained high demand for coarse grains is maintained. No technology can remain-viable in the face of constantly declining demand price of crops. But if the demand for coarse grain crops continues to maintain its present pattern that is its use for human consumption largely by the poor and by the subsistence farmers where the crops are grown, there seems little chance for yield increasing technologies to have sustained impact on production at the national level. Hence, demand for diversification of coarse grain crops in the form of animal feeds, processed foodstuff and multiple products becomes imperative to help the coarse grain crops.

Reference:

1- Jodha, N.S. and Singh, R.P. ,(1982), 'Factor Constituting Growth of Coarse Grain in Semi Arid Tropical India' *Indian journal of Agricultural Economics'*, Vol. 37, No. 3, pp 346-354.

2- Thakur, C., (1980), *'Scientific Crop Production'* Vol. 1, p 186, metropolitan Book Co. Pvt. Ltd.

3- *Ibid*, p 260.

4- Swarna, S., (1989), 'Pattern of Pulse Production an Analyses of Growth Trend' *Economic and Political Weekly*, Dec. 23-30, p A167.

Chapter - 7

Diffusion of Green Revolution

DIFFUSION OF GREEN REVOLUTION

Green revolution means adoption of new ideas in farming system e.g. High Yielding Varieties of seeds and supporting factors like assured irrigation, chemical fertilizers and mechanical implements that are integral part of the green revolution which introduced in India in 1966-67. For the development of society in any region, there is great need for the diffusion and adaptation of improved ideas and practices in almost all the fields of human activity. It is more so in the developing countries, because technological change and diffusion of new ideas could bring about speedy and intensive change in the economic and social life of the people. In the development of Indian agriculture speedy and extensive introduction, technological change (diffusion of green revolution) is one of the crucial factors. The technological changes consist of adoptions of farming techniques such as the use of improved variety of seeds, fertilizers, pesticides and fungicides, modern agricultural implements, improved irrigation facilities and soil and moisture conservation techniques which requires an intensive researches.

However, in the recent past food production in India has increased to a considerable level and it has not only become self sufficient in food grains, but also has some better stock as well. This growth in agriculture has been possible because of certain degree of technological change and adoption of agricultural innovations.

The diffusion of new strategies is a process in course today supersede yesterday. Considerable time elapses before the cultivators occupy a new technological development, they are to be conversed of its utility, they

should know, to introduce it, and finally they should also be in a position to bear the risk involved in the adoption of new ideas in the beginning. The adoption process is, therefore, not simple as it involves several considerations. It is a process consisting of learning, dividing and acting over a period of time.

Regarding the diffusion of green revolution several hypotheses have been formulated to explain it. Such as farmers are not properly motivated, lack of knowledge, failure of extension agencies to bring about the changes, weather uncertainties, and social structure of the farmers and so on.

Many events clearly reveal that new technology is not adopted promptly in any region, but it takes time for the acceptance to all over the majority of the people. In the beginning there was tough resistance but gradually becomes weaken with the constant effort of the extension workers as they conceive the adopter with the utility and profits of that technology. However in the present study an attempt has been made to find out the level of diffusion of green revolution in the region under study.

For the analysis to the level of diffusion of green revolution three major variables have been taken into consideration.

(i) Percentage of net area irrigated.

(ii) Fertilizers consumption

(iii) Modern agricultural equipments

However, the high yielding verities of seeds are very important regarding the diffusion of green revolution. In the present analysis high yielding verities of seeds have been considered hundred percent adaptations in the study area. Therefore, it does not make any significance in the study of spatial diffusion of green revaluation. For the analysis of level of diffusion of variables of green revolution 'z' score statistical technique has been used which explains.

$$Z = X-\overline{X} / S.D.$$

The 'Z' score of each variable has been calculated separately and then it has been made composite 'Z' score based on five years moving average. The discussions of each variable are as follows in sequent manner.

IRRIGATION:

Irrigation is indeed the life-breath of agriculture. Agricultural productivity is greatly depends on the availability of water, its proper use and management. Amongst the quick yielding inputs responsible for accelerating agricultural productivity during the short period, assured irrigation facilities not only help in increasing productivity but also their availability is pre-condition for application of other inputs. Due to this reason, in the re-vitalized agricultural production programme, the use of high yielding variety of seeds, together with the high doses of fertilizers, has inextricably lined with assured water resources either through reliable natural rain water or through artificial irrigation . Experiments conducted at various research centers for appraisal of the joint requirements of crucial inputs for attaining optimum crop yields, irrigation factors has been identified to be one of the most important factors Irrigation can thus be the key input, offering the possibility of the greatest increase in the value of production which was the motto of green revolution.

Indian agriculture is the gamble of monsoon, which is characterized by erratic and uncertainty of rainfall, besides high variability of the rainfall is common phenomenon. Therefore, assured irrigation becomes a base for the success of green revolution together with other inputs which includes chemical fertilizers, high yielding variety of seeds, etc.

Table – 7.1

INDICES OF IRRIGATION

	1975			1980			1985			1990			1995			2000		
Name of blocks	X	(X-$\overline{X}$=x) x^2	"Z" score	X	(X-$\overline{X}$=x) x^2	"Z" score	X	(X-$\overline{X}$=x) x^2	"Z" score	X	(X-$\overline{X}$=x) x^2	"Z" score	X	(X-$\overline{X}$=x) x^2	"Z" score	X	(X-$\overline{X}$=x) x^2	"Z" score
Marhera	78.3	228.01	1.19	86.7	166.4	0.9	97.8	200.78	1.44	96.7	136.42	1.29	83.5	28.30	0.62	92.4	2.07	0.20
N.kalan	76.9	187.61	1.08	89.8	256	1.12	90.4	45.83	0.69	87.2	4.75	0.24	96.5	58.98	0.90	98.6	58.36	1.11
Sheetalpur	81.4	331.24	1.43	87.9	198.8	0.99	96.5	165.63	1.31	87.77	3.06	0.19	94.13	28.19	0.62	97.8	46.78	0.99
Sakeet	69.3	37.21	0.48	86.5	161.2	0.89	87.04	11.62	0.34	25.7	114.06	1.18	95.18	40.44	0.74	87.7	18.4	-0.61
Sahawar	49.3	193.21	-1.09	61.13	160.5	-0.89	71.03	158.76	-1.28	77.5	56.55	-0.83	96.8	63.68	0.93	96.9	35.28	0.86
Sirpura	69.4	38.44	0.48	82.2	70.56	0.59	86.3	7.12	0.27	86.3	1.63	0.14	90.12	1.69	0.15	87.4	12.67	-0.51
Kasganj	79.7	272..25	1.30	85.05	126.5	0.79	97.3	186.86	1.39	94.14	83.17	1.01	94.3	30.03	0.64	96.6	31.8	-0.81
Amanpur	58.3	24.01	-0.38	83.5	94.09	0.68	76.5	50.83	-0.72	89.5	20.07	0.49	96.7	62.09	0.92	98.4	55.35	1.08
Soron	50.9	151.29	-0.97	60.35	180.9	-0.94	79.98	13.32	-0.37	79.15	34.45	-0.65	90.4	2.49	0.18	96.8	34.10	0.84
Aliganj	59.3	15.21	-0.30	64.9	79.21	-0.62	75.76	61.83	-0.8	75.5	90.63	-1.05	77.4	130.4	-1.34	89.79	1.36	-0.17
G.Dundwara	40.6	510.76	-1.78	44.03	886.2	-2.09	69.82	190.71	-1.40	68.49	273.24	-1.83	66.6	493.72	-2.6	74.1	284.25	-2.45
Jaithra	53.8	88.36	-0.74	60.85	167.7	-0.91	75.56	65.12	-0.82	79.2	33.87	-0.64	86.2	6.86	-0.30	92.4	2.07	0.20
Patiali	46.4	282.24	-1.32	52.14	496.15	-1.52	69.85	189.88	-1.40	70.9	199.24	-1.56	79.3	90.63	-1.11	80.4	111.51	-1.53
Jalesar	69.9	44.89	0.52	84.6	116.6	0.76	91.5	61.93	0.8	95.13	102.21	1.12	88.9	0.006	0.009	88.7	5.10	-0.32
Abagarh	64.4	1.44	0.09	78.82	25.2	0.35	89.22	31.24	0.57	93.15	66.02	0.90	96.3	55.95	0.87	87.5	111.97	-0.50
	$\overline{X}$=63.2 SD=12.66			$\overline{X}$=73.8 SD=14.18			$\overline{X}$=88.63 SD=9.80			$\overline{X}$=85.02 SD=9.01			$\overline{X}$=88.82 SD=8.53			$\overline{X}$=90.96 SD=6.88		

X = area irrigated percentage of total cropped area

$\overline{X}$ = average of X

SD = standard Deviatio

Corrections for changes of total area?

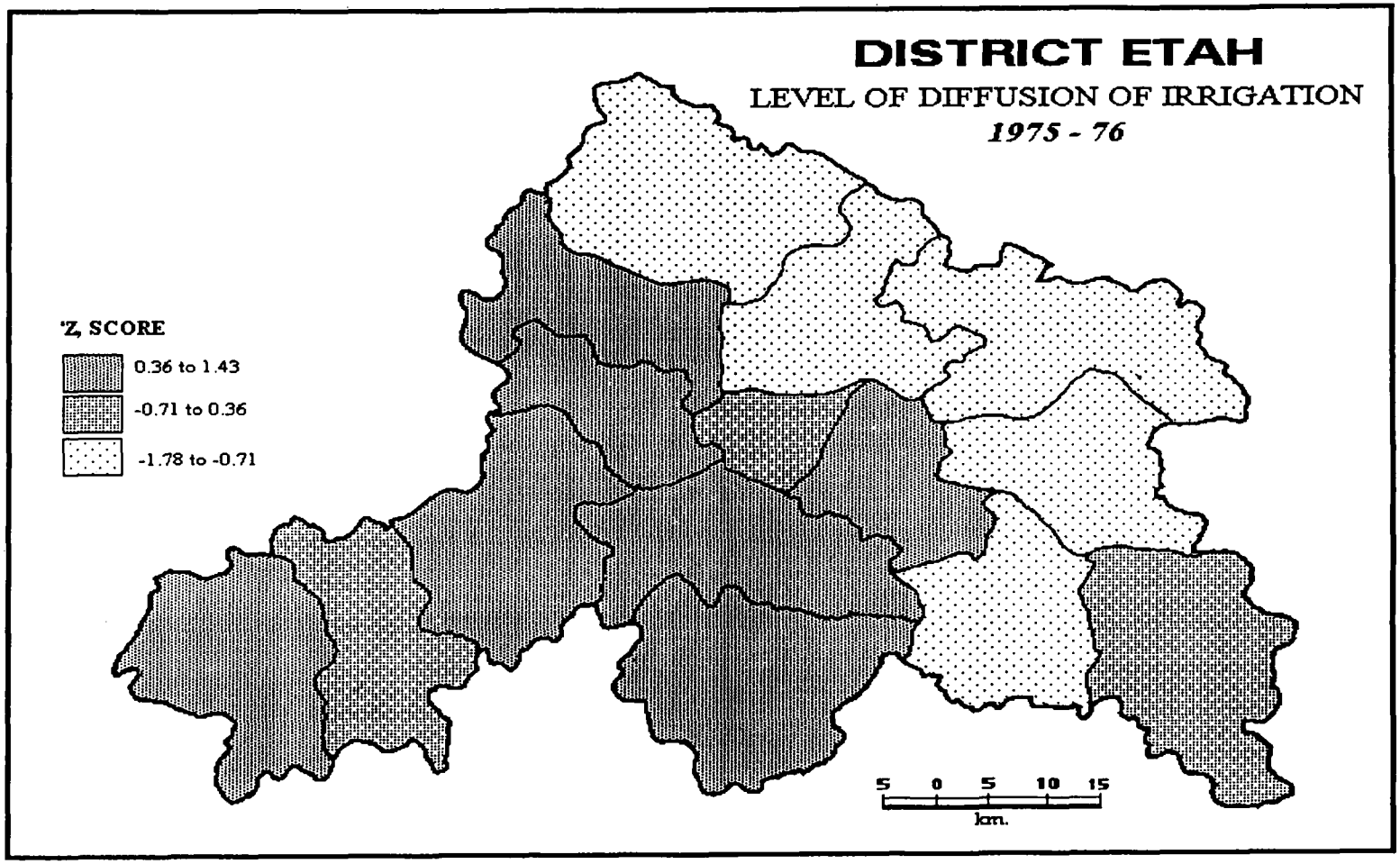

DISTRICT ETAH
LEVEL OF DIFFUSION OF IRRIGATION
1975 - 76
'Z' SCORE
0.36 to 1.43
-0.71 to 0.36
-1.78 to -0.71
5 0 5 10 15
km.

Fig – 7.1

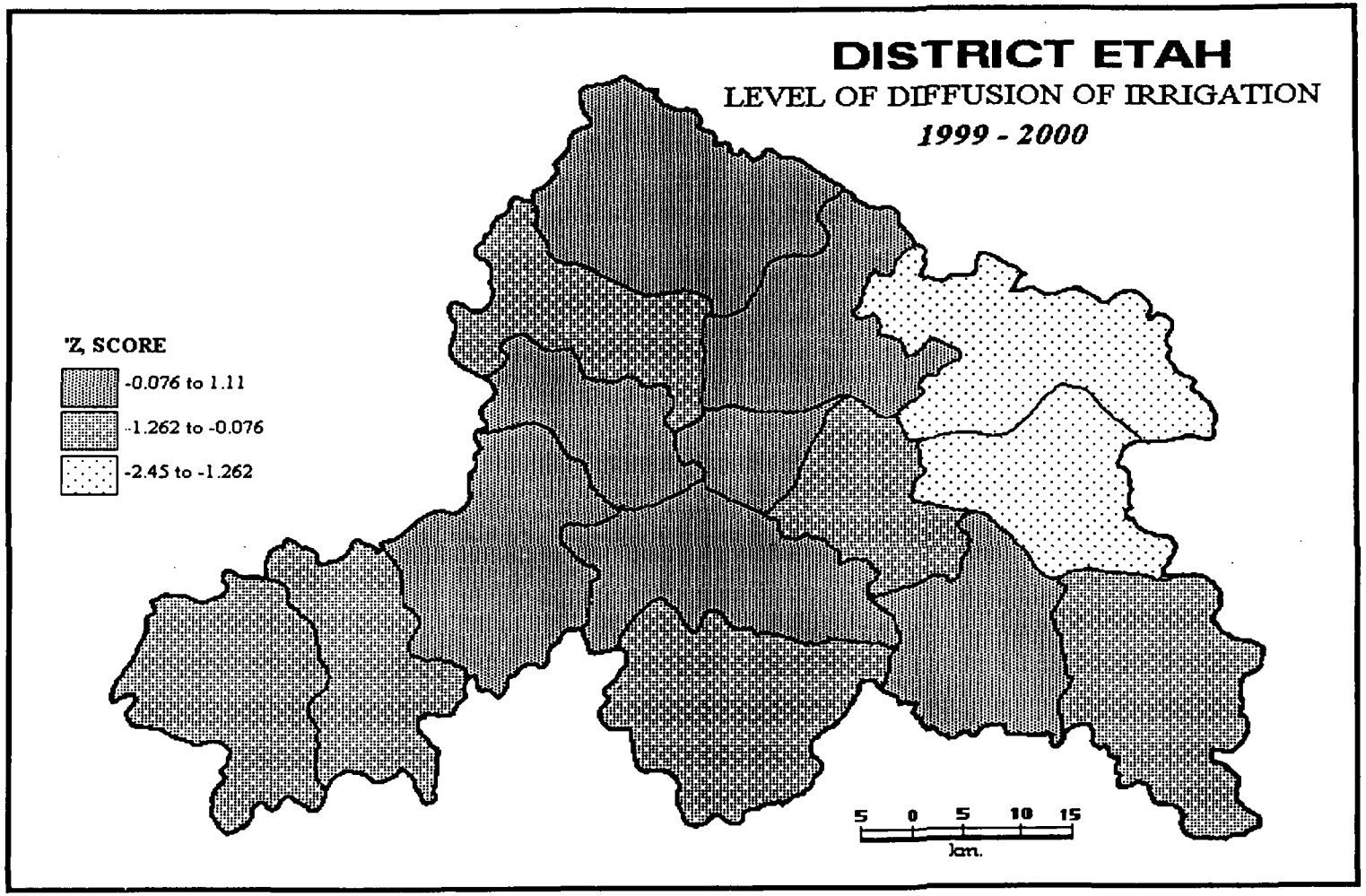

DISTRICT ETAH
LEVEL OF DIFFUSION OF IRRIGATION
1999 - 2000
'Z, SCORE
-0.076 to 1.11
-1.262 to -0.076
-2.45 to -1.262
5 0 5 10 15
km.

Fig – 7.2

The district Etah which lies in the Ganga-Yamuna doab has a vast reservoir of surface and groundwater, fertile soil and ~~better~~ climatic conditions. The perennial river of the Ganga system drains this district. The vast level plain and gentle slope provides easy base for the construction and development of the canal, the study area received 60cm to 70cm rainfall and more than 90% of the rainfall takes place during the rainy season , which spans over more than two to three months, ~~and~~ rest of the year remains dry. Irrigation thus is very necessary for the development of agriculture. Though the net irrigated area of the region accounts about 91% in the current years, yet a great variations exist from one block of the district to another. On the basis of 'Z' score the whole district has been categorized into three major groups' i.e. high, medium and low irrigation, which are as follows-

HIGH LEVEL OF IRRIGATION

High level of irrigation consists of the development block Sheetalpur, Marehra, Nidhoulikalan, Kasganj, Jalesar, Sirpura and Sakeet in 1975, which represent by the value of 'z' score ranges1.43 to 0.36. High level of irrigation area represents, 75 percent of net irrigated area, in 1975 86 percent in 1980, 93 percent in 1985, 95 percent in 1990, 96 percent in 1995 and 97 percent in 2000. Two more blocks Awagarh and Amanpur were added in the high level of irrigation categories in 1980. While during the period of 1990 only six blocks are left in the category of high level of irrigation due to the slow development of irrigation facilities in Sheetalpur, Nidhoulikalan and Sirpura. While Marehra, reached up to the 97% of net area irrigated in 1990. Finally, the region of high level of irrigation, Nidhoulikalan have 98.6 percent irrigated area, Amanpur 98.4 percent Sheetalpur 97.4 percent, Sahawar 96.9 percent, Soron 96.8 percent net irrigated area in 2000. Besides, the changing position of different blocks from medium to high and vice-versa the magnitude of irrigation has also changed from 75 percent in 1975 to 98 percent in 2000.

MEDIUM LEVEL OF IRRIGATION

Medium level of irrigation region comprises the development blocks of Awagarh, Aliganj and Amanpur, which comes within the 'z' score range from 0.36 to –0.71, and has an average 60.6 percent net irrigated area in 1975. In current years, the medium level of irrigation region comprises, of six-development blocks namely-Awagarh, Jalesar, Aliganj, Kasganj, Sirpura and Sakeet. The area under irrigation increased from 60.6 percent in 1975 to 89.44 percent in 2000.

LOW LEVEL OF IRRIGATION

Only two development blocks out of 15 in the study area comes under low level of irrigation such as Patiali and Ganjdundwara, accounts 77.25 percent area under irrigation in 2000. In 1975 there were five development blocks under the low level of irrigation region. After the gap of 5 years it comes down to two development blocks and the area under irrigation reached from 48.2 percent (in Jaleasr, Patiali, Jaithra, Soron and Sahawar) in 1975 to 48.85 percent (in Patiali and Ganjdunwara) in 1980. Once again, the number of development blocks after five years increased from two to six under the category of low level of irrigation region but the percentage of area under irrigation increased from 48.85 percent in 1985 to 73.08 percent in 1975. With the passage of time, the execution of means of transportation and communication and other infrastructure and facilities helped the adaptation of green revolution subsequently new areas are brought under irrigation. Thus, in 2000 the area under irrigation has gone up to 77.25 percent comprising of two development blocks namely Patiali and Ganjdundwara (Table- 7.1 and figure-7.2).

FERTILIZERS:

The key to growth in the agricultural production for short period lies in intensive use of chemical fertilizers. In the new strategy, fertilizer has played a key role because when soil fertility is low, better germ plasm fails to

show postulated yields differential. The continuous deteriorating soil fertility on account of regular cultivation can also be replenished to a great extent by re-supplying nitrogen in the soil through the use of fertilizers, and plant yields can be stepped up by the use of adequate nutrition in the form of fertilizers. Fertilizers thus can play a significant role in providing a major break through in agricultural production.

Researches have revealed ~~the~~ great potentialities for sustained increase in crop production can be attained through greater and more efficient use of fertilizers and manures. The annual report of FAO states the use of fertilizers as a "spearhead of agricultural development" because wherever efforts are made to raise the agricultural efficiency and production for fast increasing population, more fertilizers and manure have invariably needed. Perhaps, even more important, on many soils they make possible good yields of valuable crops that would not grow at all without the use of fertilizers or would grow more poorly.

Fertilizers also improve the "biological quality" and ~~make good~~ the oases of essential nutrients continuously taking place due to cropping, leaching and erosion. Infact, even if all the available organic matter is applied back to the soils, there will still be scope for applications of fertilizers for maintaining it at high level of productivity from year to year even during abnormally low

Table – 7.2

INDICES OF FERTILIZERS CONSUMPTIONS PER HECTARE (IN KILOGRAMS)

Name of blocks	1975			1980			1985			1990			1995			2000		
	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score
Marhera	40	264.17	1.96	73	602.21	1.36	51.23	.673	-0.018	79	77.44	0.46	104.3	107.74	0.82	123.1	106.09	-0.69
N.kalan	20	13.91	-0.45	45	11.97	-0.19	41.47	100.6	-0.67	75	23.04	0.25	89.25	21.8	-0.37	103.5	86.49	-0.62
Sheetalpur	27	10.69	0.39	81	1058.85	1.80	65.79	204.2	0.95	71	0.64	0.042	98.4	20.07	0.35	101.6	125.44	-0.75
Sakeet	18	32.83	-0.69	50	2.37	0.08	41.35	103.02	-0.67	64	38.44	-0.32	84.9	81.36	-0.71	104.6	67.24	-0.55
Sahawar	25	1.61	0.15	33	239.01	-0.85	62.73	126.11	0.75	69	1.44	-0.06	102	65.28	0.64	136.3	552.25	1.58
Sirpura	23	0.53	-0.08	34	209.09	-0.8	39.32	148.35	-0.81	78	60.84	0.41	103	82.44	0.72	130.3	306.25	1.17
Kasganj	36	150.55	1.48	73	602.21	1.36	78.57	732.78	1.81	106	1281.64	1.89	108	198.24	1.11	115.2	5.76	0.16
Amanpur	16	59.75	-0.93	22	700.13	-1.47	37.35	200.22	-0.94	46	585.64	-1.27	89.2	22.27	-0.37	127.4	213.16	0.98
soron	13	115.13	-1.29	15	111.9.57	-1.85	16.65	1214.52	-2.32	41	852.64	-1.544	70.3	557.9	-1.87	80	1075.84	-2.20
Aliganj	12	137.59	-1.41	54	30.69	0.3	58.53	49.42	0.46	63	51.84	-0.38	90.4	12.39	-0.27	96.5	265.69	-1.09
G.Dundwara	30	39.13	0.75	54	30.69	0.30	63.76	150.3	0.81	113	1831.84	2.26	121.7	771.72	2.20	129.4	275.56	1.11
Jaithra	20	13.91	-0.45	45	11.97	-0.19	62.09	112.14	0.70	72	3.24	0.095	80.4	182.79	-1.07	98.8	196	-0.94
Patiali	25	1.61	0.15	37	131.33	-0.63	40.80	114.49	-0.71	69	1.44	-0.06	98.3	19.18	0.34	118.3	30.25	0.37
Jalesar	16	59.75	-0.93	58	91.01	0.53	51.32	0.032	-0.012	54	262.44	-0.85	79.4	210.83	-1.15	112.4	0.16	-0.026
Awagarh	35	127.01	1.36	53	20.61	0.25	61.58	101.6	0.67	53	295.84	-0.90	89.3	21.34	-0.36	114.9	4.41	0.14
	$\bar{X}$=23.73 SD=8.27			$\bar{X}$=48.46 SD=18			$\bar{X}$=51.50 SD=14.96			$\bar{X}$=70.2 SD=18.91			$\bar{X}$=93.92 Sd=12.58			$\bar{X}$=112.8 SD=14.85		

***X*= fertilizers in Kilograms per Hectare**

$\bar{X}$ = average of X

SD=standard Deviation

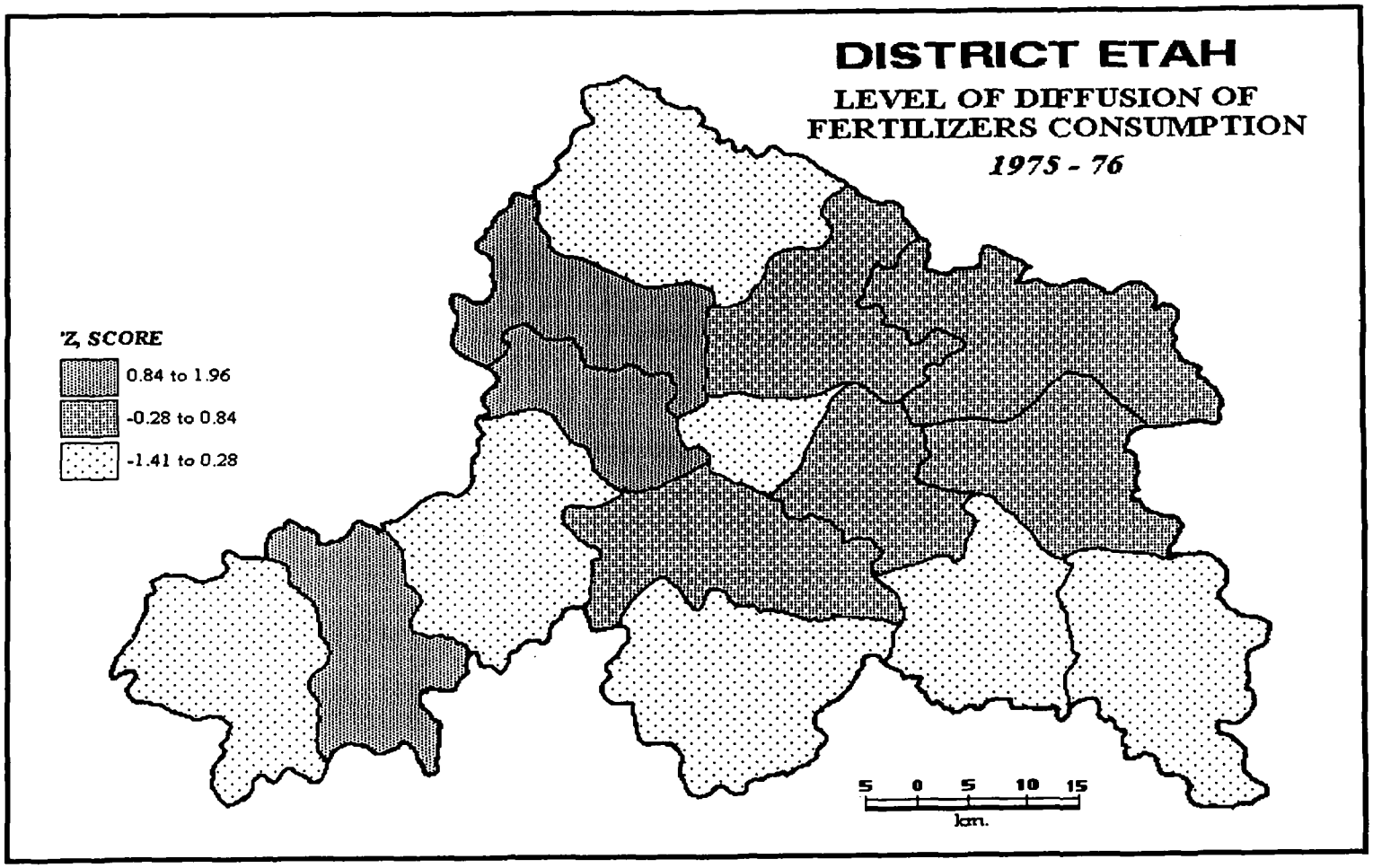

DISTRICT ETAH
LEVEL OF DIFFUSION OF
FERTILIZERS CONSUMPTION
1975 - 76
'Z' SCORE
0.84 to 1.96
-0.28 to 0.84
-1.41 to 0.28
5 0 5 10 15
km.

Fig – 7.3

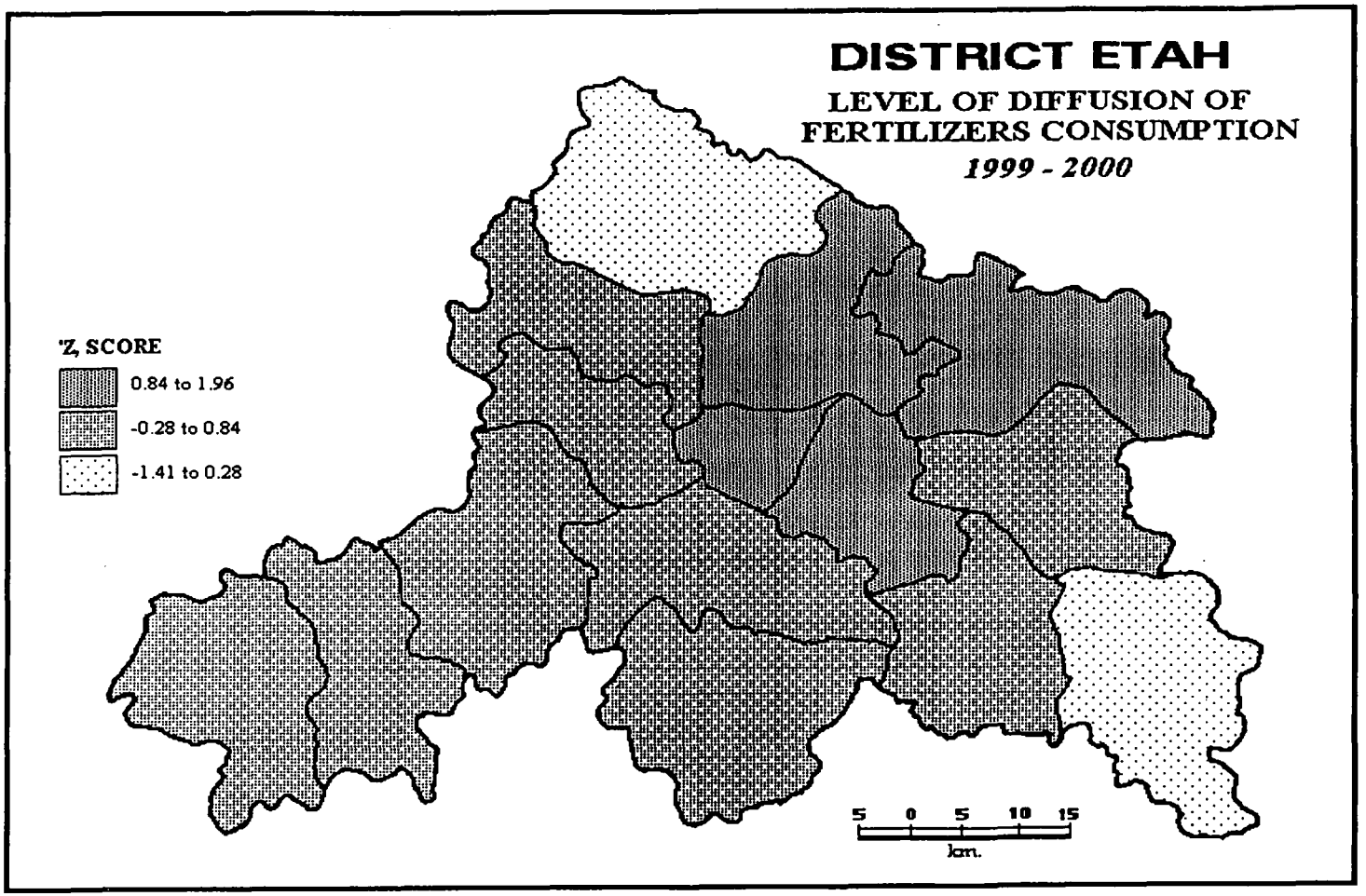

DISTRICT ETAH
LEVEL OF DIFFUSION OF
FERTILIZERS CONSUMPTION
1999 - 2000
'Z, SCORE
0.84 to 1.96
-0.28 to 0.84
-1.41 to 0.28
5 0 5 10 15
km.

Fig – 7.4

rainfall years fertilized crops give higher yields than unfertilized crops.The reason is that the fertilized crops attain a good initial state and better development of both root and shoot, which enable them to endure drought to greater extent than unfertilized crops. Due to these reasons, two main planks of the new strategy, e.g., multicropping and the improved variety of high yielding seeds, have largely been made dependent upon the availability of the required doses of fertilizers input to get a satisfactory result.

In may also be emphasized here that the continuous use of chemical fertilizers reduces the humus content of the soil. In the absence of humus, the physical structure of the soil undergoes a vast changes and characteristics of soil and its water holding and absorbing capacity is reduced Substitution by organic manure, therefore it is imperative which may replace the desirable physical and biological properties to the soil.

District Etah experienced green revolution in the second phase of the introduction of green revolution in Utter Pradesh. The consumption of fertilizers is determined by availability of assured irrigation, high yielding variety of seeds, and better economic conditions of the farmers, social awareness and high literacy rate. The study area is manifested with varying physico-cultural and socio-economic conditions, thus it is obvious to have attain a varying degree of consumption of fertilizers at spatio-temporal level. Thus it is seen from the date that it accounts, 23kg per hectare in 1975, 48.46 kg per hectare in 1980, 51.5 kg per hectare in 1985, 70.2 kg per hectare in 1990, 93.92 kg per hectare in 1995, 112.8 kg per hectare in 2000. The consumption of fertilizers in spatial context is not uniform, it subject to vary from place to place depending upon the ecological setting of the area. The study area has been grouped into three categories such as high, medium and low level of consumption of fertilizers.

½ part of the water retention capacity depends on mineral particles (particularly clay)

xx/ about half of the employed in Denmark!

HIGH LEVEL CONSUMPTION OF FERTILIZERS:

The high level of consumption of fertilizers with indices ranging from 1.96 to 0.84 score value, comprises three blocks in 1975 namely- Marehra Kasganj and Awagarh. The average consumption of fertilizers was 37 kg per hectare in 1975 where as in 2000, the development blocks replaced by the development blocks of Sahawar, Sirpura Ganjdundwara and Amanpur. The average consumption of fertilizers in the region of high level of consumption has reached 130.85 kg per hectare in 2000.

MEDIUM LEVEL CONSUMPTION OF FERTILIZERS:

The medium level of consumption of fertilizers with the indices ranging from +0.84 to –0.28 score value, comprises of five development blocks in 1975 namely – Sahawar, Sirpura, Ganjdundwara, Patiali and Sheetalpur. The average consumption of fertilizers in these blocks was 26kg per hectare and the net irrigated area was 57.8 percent during 1975. In 2000, the region of medium level of consumption fertilizers of 1975 have replaced by other five development blocks namely, Marehra, Patiali, Kasganj, Awagarh and Jalesar. The average consumption of the fertilizer in the medium level has reached from 26 kg per hectare in 1975 to 11 per hectare in 2000.

LOW LEVEL CONSUMPTION OF FERTILIZERS:

The low level of consumption of fertilizers with indices below – 0.28 'z' score value, which comprises of seven development blocks namely Soron, Aliganj, Jaithra, Nidualikalan, Sakeet, Jalesar and Amanpur in 1975 and the average consumption of fertilizers was 16.428 during the same period. The average consumption of fertilizers in the low level consumption region has reached 40.05 kg per hectare in 1985, 83.25 kg per hactare in 1995 and 97.5 kg per hectare in 2000 and the development blocks comprises Sakeet , Ndidhuli alan , Shaatapur, Jaithra, Aliganj and Soron (Table- 7.2 and Fig- 7.4.)

MECHANICAL APPLIANCES:

The third most important factor for the successful adaptation of green revolution is the improved mechanical technique. It is also a most important indicator to show the level of the diffusion of green revolution in any agricultural unit. By mechanization we mean replacement of animal and human power by machinery wherever it is possible, ploughing is to be done by tractor, sowing and putting of fertilizers by drilling machine, and reaping and harvester by the combined harvesters, thresher and so on. Machines work faster and accurately than man by himself produces very little but with the help of machines one can produce much more.

In the present study about the diffusion of the mechanical appliances, I have taken the availability of mechanical implements per hundred hectare of agricultural land and a composite average has been calculated of all the implements in a particular years. Here the agricultural implements include availability of tractors per hundred hectares, thresher per hundred hectare, drilling machines per hundred hectares, pumping sets per hundreds hectares harrow and cultivators per hundred hectares, etc. here the data of mechanical implements are used since 1980 because, the data after 1980 on block level is not available.

The use of mechanical implements in the district Etah is higher than any other parts of the Ganga-Yamuna *doab*. Mechanization is affected by the size of land holding, economic position, social status, literary and exposure to mass media and social awareness etc. size of land holding is one of the important factors, which determine the use of technology to a greater extent. It is evident that there is positive co-relation between the use agricultural innovations (mechanical implements) and the size of land holding.

The use of mechanical implements in the study area is not uniform but subject to vary in time and space because of diverse ecological setting. Broadly the region has been divided into three major categories based on

the level of use of implements such as high, medium and low. Which are follows as.

HIGH LEVEL USE OF MECHANICAL IMPLEMENTS:

The region using high level of implements having indices above + 1.064 'Z' score value comprising of two development blocks namely, Jalesar and Marehra in 1980 which have 0.35 tractors per hundred hectare of agricultural land, 7.49 pumping sets per hundred hectare of land, 1.91 threshing machines 0.43 harrows and cultivators per hundred hectare of land, etc. the average composite index value of the high level availability of the mechanical appliance was 2.18 in 1980. High-level use of mechanical implements region replace by the blocks of the Sahawer and Amanpur during the period of 2000. The average composite index value of the use of mechanical implements per hundred hectare have reached up to the 13.9 in Sahawar block and 14.67 in the Amanpur development blocks, that shows the availability of mechanical implements e.g. 1.33 tractors per hundred hectare of net area 15.55 seed driller per hundred hectare of net area, 26.8 pumping sets per hundred hectare of land, 6.48 threshing machine per hundred hectare of land, 21.28 harrow and cultivators per hundred hectares of land in 2000. This changing nature of the position of development blocks may be attributed to the implements of socio-economic conditions of the farmers.

Table – 7.3

INDICES OF MECHANICAL APPLIANCES

Name of bloks	1980			1985			1990			1995			2000		
	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" core	X	$(X-\bar{X}=x)$ x^2	"Z" score	X	$(X-\bar{X}=x)$ x^2	"Z" score
Marhera	2.54	1.79	2.80	3.41	3.92	-1.144	4.898	4.549	-0.982	5.3	4.831	-1.114	9.43	1.06	-0.52
N.kalan	1.13	0.0049	-0.146	318	4.88	-1.277	4.59	5.919	-1.105	5.88	2.883	-0.860	12.03	2.464	0.79
Sheetalpur	1.3	0.01	0.209	3.62	3.132	-1.023	5.3	2.968	-0.793	7.12	0.209	-0.232	12.38	3.686	0.97
Sakeet	1.2	0	0	3.32	4.284	-1.196	4.42	6.775	-1.198	4.82	7.606	-1.397	10.36	0.01	-0.05
Sahawar	1.08	0.0144	-0.25	5.18	0.044	-0.121	7.1	0.0059	0.035	7.8	0.0492	0.1125	13.9	11.83	1.74
Sirpura	0.86	0.1156	-0.712	8.11	7.398	1.572	11.12	16.785	1.887	12.57	24.920	2.53	12.5	4.161	1.03
Kasganj	0.73	0.220	-0.985	4.77	0.3844	-0.358	6.45	0.328	-0.263	6.41	1.364	-0.591	12.52	4.24	1.04
Amanpur	1.35	0.022	0.314	6.61	1.4884	0.705	4.64	5.678	-1.097	9.44	3.467	0.943	14.67	17.72	2.13
soron	1.01	0.036	-0.398	4.92	0.2209	-0.271	6.58	0.1962	-0.204	6.13	2.096	-0.733	9.64	0.67	-0.41
Aliganj	1.69	0.24	1.027	8.26	8.236	1.658	9.84	7.935	1.297	9.39	3.283	0.918	12.38	3.68	0.97
G.Dundwara	0.49	0.504	-1.488	5.96	0.324	0.329	9.08	4.231	0.947	8.06	0.232	0.244	8.35	4.45	-1.07
Jaithra	1.44	0.0576	0.503	5.97	0.336	0.312	7.68	0.431	0.302	7.54	0.00144	-0.0192	9.67	0.62	-0.40
Patiali	1.2	0	0	7.87	6.15	1.433	10.05	9.162	1.394	9.79	4.892	1.121	10.95	0.24	0.24
Jalesar	1.42	0.3844	1.299	6.22	0.68	0.479	8.48	2.122	0.671	7.48	0.0096	-0.0496	8.67	3.20	-0.90
Awagarh	1.36	0.0256	0.335	3.45	3.763	-1.12	5.12	3.621	-0876	5.97	2.585	-0.815	9.58	0.77	-0.44

X = use of mechanical appliances per hundred hectares

$\bar{X}$ = average of X

SD = standard Deviation

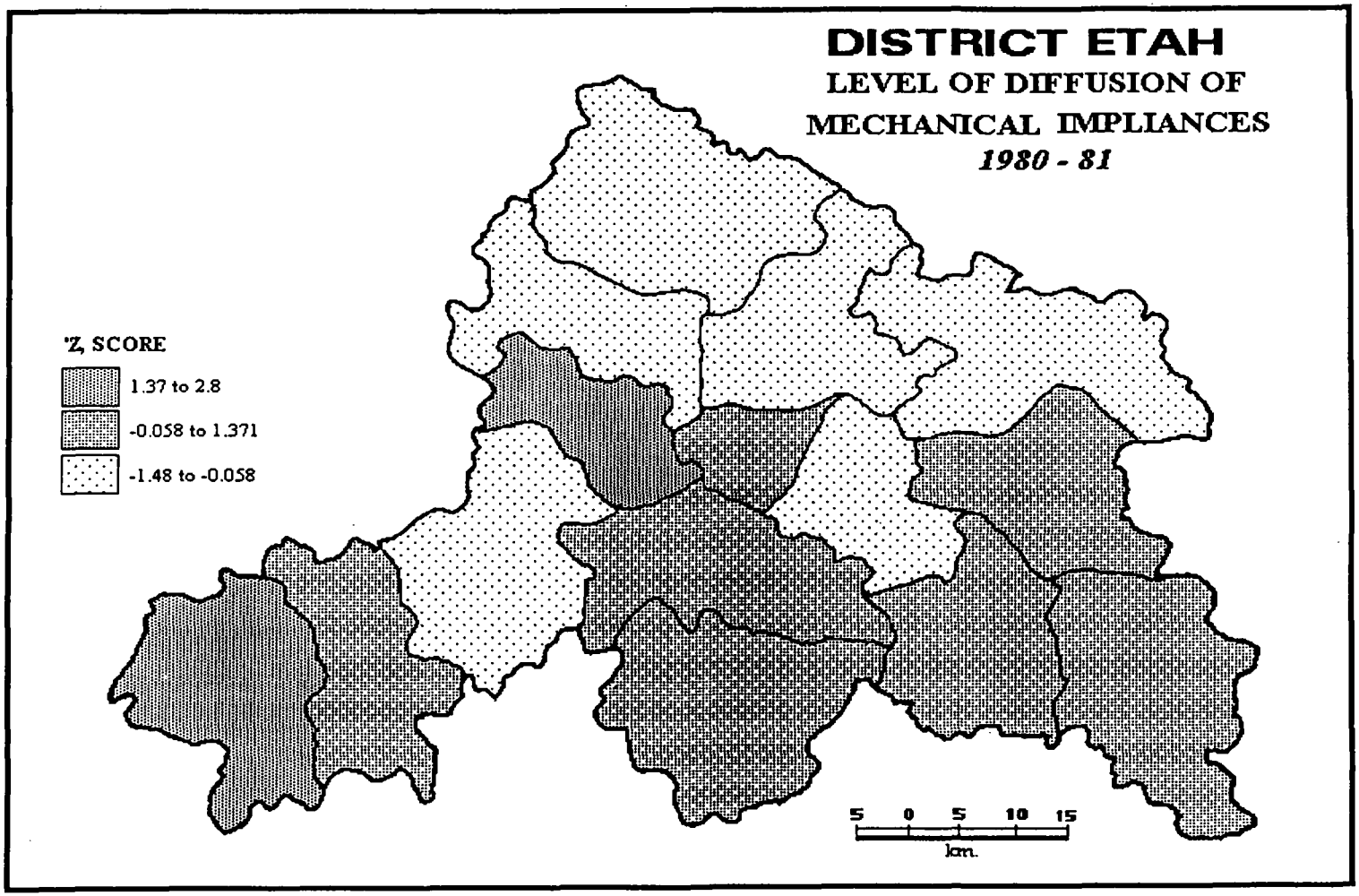

DISTRICT ETAH
LEVEL OF DIFFUSION OF
MECHANICAL IMPLIANCES
1980 - 81
'Z' SCORE
1.37 to 2.8
-0.058 to 1.371
-1.48 to -0.058
5 0 5 10 15
km.

Fig – 7.5

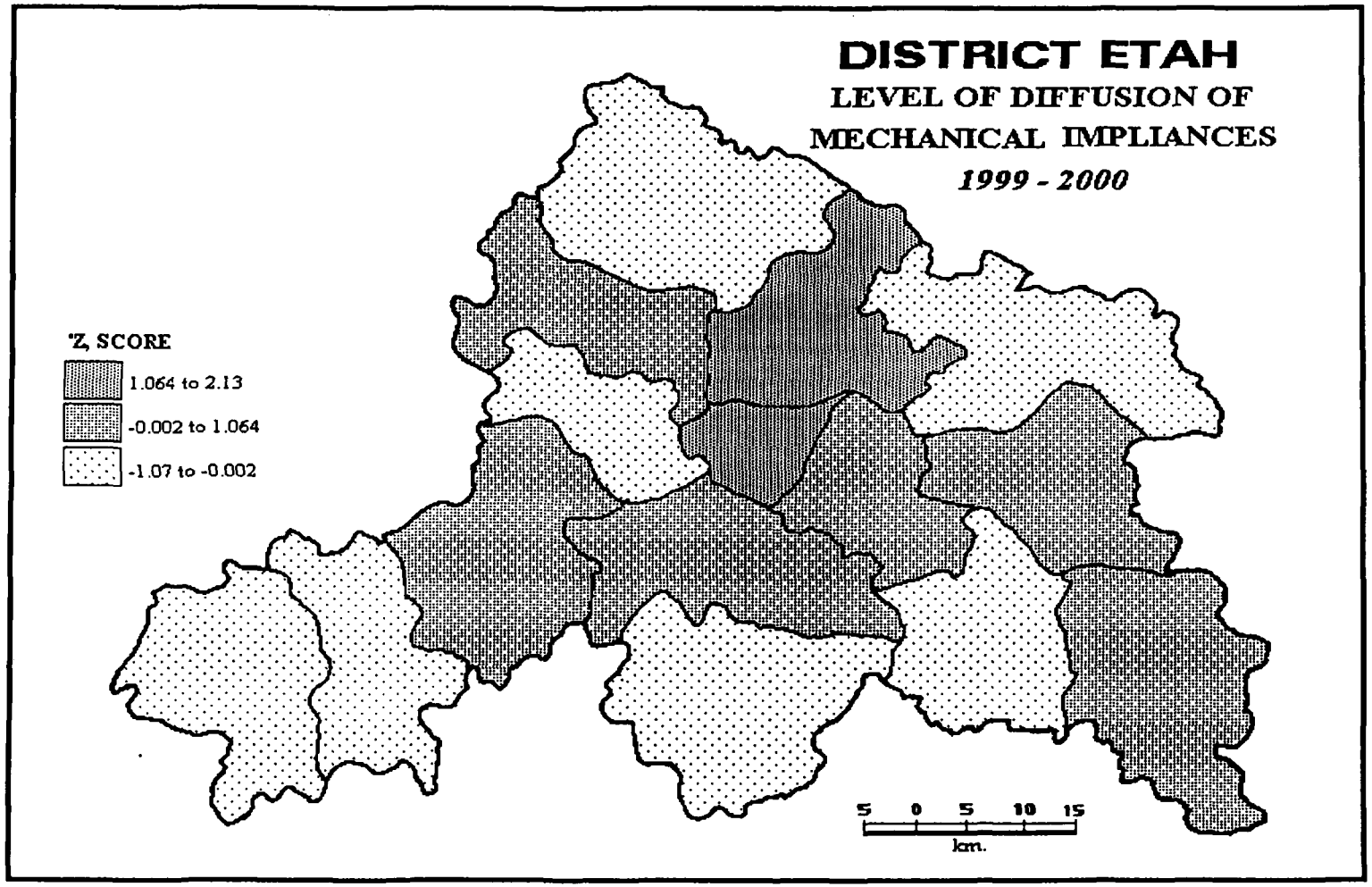

DISTRICT ETAH
LEVEL OF DIFFUSION OF
MECHANICAL IMPLIANCES
1999 - 2000
'Z' SCORE
1.064 to 2.13
-0.002 to 1.064
-1.07 to -0.002
5 0 5 10 15
km.

Fig – 7.6

MEDIUM LEVEL USE OF MECHANICAL IMPLEMENTS:

Regions having medium level use of mechanical have represented with the indices ranging from +1.064 to –0.002 'z' score value, comprising of seven development blocks namely Sheetalpur , Sakeet , Amanpur , Aliganj , Jaithra, Patiali and Awagarh in 1980. Which represent average availability of mechanical implements 1.326 per hundred hectare of net cultivated area in 19980. The number of development blocks reduced in the category of medium level uses of mechanical implements during the period of 2000. Presently, it comprises, Nidhoulikalan, Sheetalpur, Sirpura, Kasganj, Aliganj and Patiali, which represent the average availability of mechanical implements in the region 0.84 per hundred hectares. Though, the total numbers of machanical implements in the region have increased but due to the reclamation of new area under plough the availability of per hundred hectares have decreased in the region of medium level use of mechanical implements.

LOW LEVEL OF MECHANICAL IMPLEMENTS:

The region having low-level use of mechanical implements have shown in the figure – 7.5 with the indices below – 0.002 'z' score Which accounts six developments blocks, e.g. Ganjdundwara, Soron , Kasganj , Sirpura , Sahawar ans Nidhoulkalan, with 0.88 per hundred hectare of net cultivated area, availability of mechanical appliances in 1980. In 1990 the numbers of development blocks have increased from six in 1980 and eight in 1990. Nidhoulikalan , Kasganj and Soron remains its low level use of implements while Awagarh, Amanpur, Sakeet, sheetalpur and Marehra are added to the low level use of implements from their high and medium categories. In 2000, seven development blocks has occupied the position under the category of low level use of mechanical implements namely, Marehra, Sakeet, Soron, Ganjdundwara, Jaithra, Jalesar and Awagarh (Table 7.3 and Figure- 7.6).

Table – 7.4

LEVEL OF GREEN REVOLUTION DIFFUSION

1975 -76

Name of Blocks	'Z' Score indices of irrigation	'Z' Score indices of fertilizers	Composite Index
Marehra	1.19	1.96	1.575
Nidhaulikalan	1.08	-0.45	0.315
Sheetal pur	1.43	0.39	0.91
Sakeet	0.48	-0.69	-0.105
Sahawar	-1.09	0.15	-0.47
Sirpura	0.48	-0.08	0.20
Kasganj	1.30	1.48	1.39
Amanpur	-0.38	-0.93	-0.655
Soron	-0.97	-1.29	-1.13
Aliganj	-0.30	-1.41	-0.855
Ganjdundwara	-1.78	0.75	-0.515
Jaithra	-0.74	-0.45	-0.595
Patiali	-1.32	0.15	-0.585
Jaleasr	0.52	-0.93	-0205
Awagarh	0.09	1.36	0.725

Table – 7.6

LEVEL OF GREEN REVOLUTION DIFFUSION

1999-2000

Name of Blocks	'Z' Score indices mechanical appliances	'Z' Score indices of irrigation	'Z' Score indices of fertilizers	Composite Index
Marehra	-0.52	0.20	0.69	0.123
Nidhaulikalan	0.79	1.11	-0.62	0.426
Sheetal pur	0.97	0.99	-0.75	0.403
Sakeet	-0.05	-0.61	-0.55	-0.403
Sahawar	1.74	0.86	1.58	1.393
Sirpura	1.03	-0.51	1.17	0.563
Kasganj	1.04	-0.81	0.16	0.13
Amanpur	2.13	1.08	0.98	1.396
Soron	-0.41	0.84	-2.20	-0.59
Aliganj	0.97	-0.17	-1.09	0.63
Ganjdundwara	-1.07	-2.45	1.11	-0.803
Jaithra	-0.40	0.20	-0.94	-0.38
Patiali	0.24	-1.53	0.37	-0.306
Jaleasr	-0.90	-0.32	-0.026	-0.415
Awagarh	-0.44	-0.50	0.14	-0.266

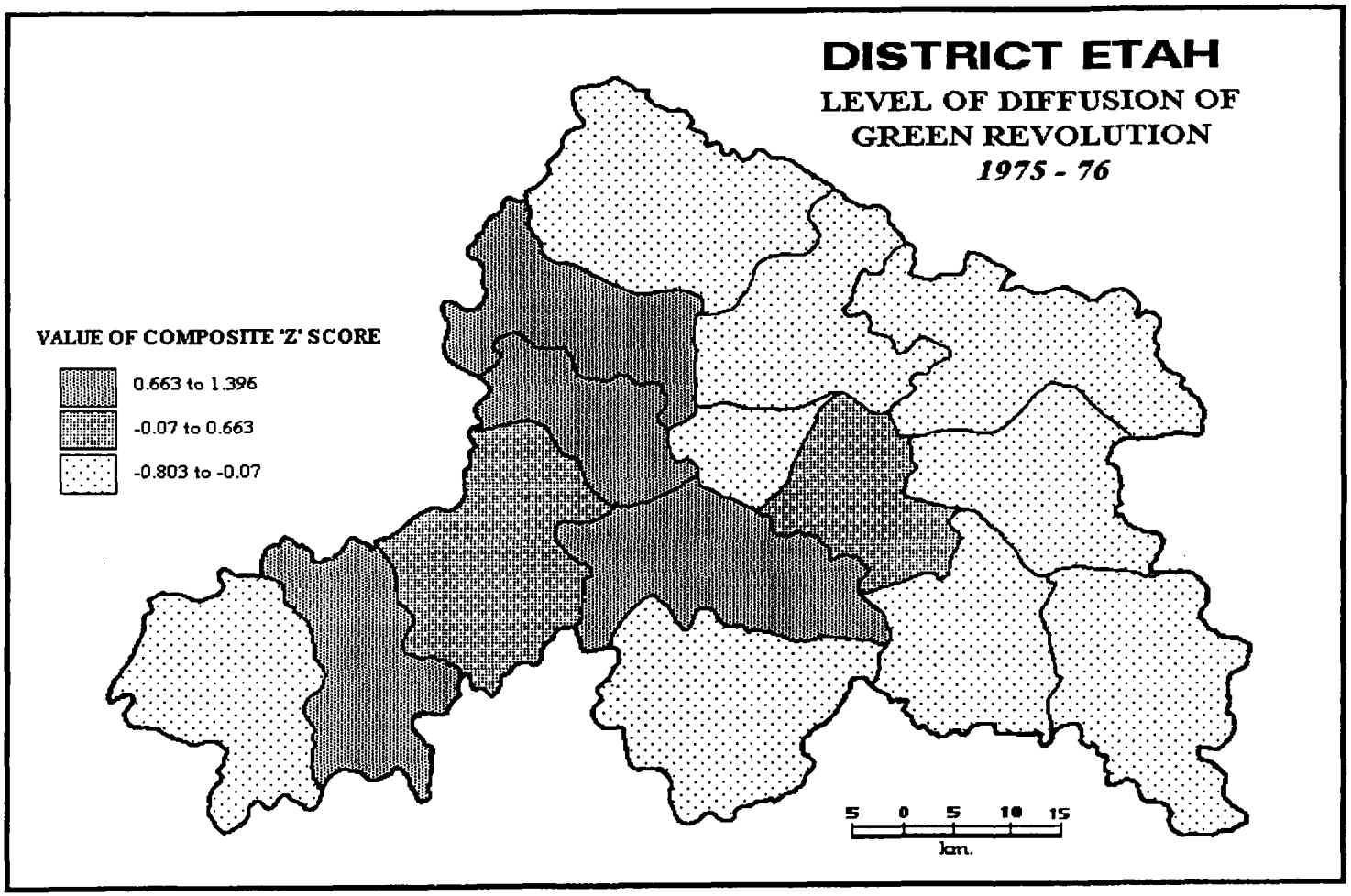

DISTRICT ETAH
LEVEL OF DIFFUSION OF
GREEN REVOLUTION
1975 - 76
VALUE OF COMPOSITE 'Z' SCORE
0.663 to 1.396
-0.07 to 0.663
-0.803 to -0.07
5 0 5 10 15
km.

Fig – 7.7

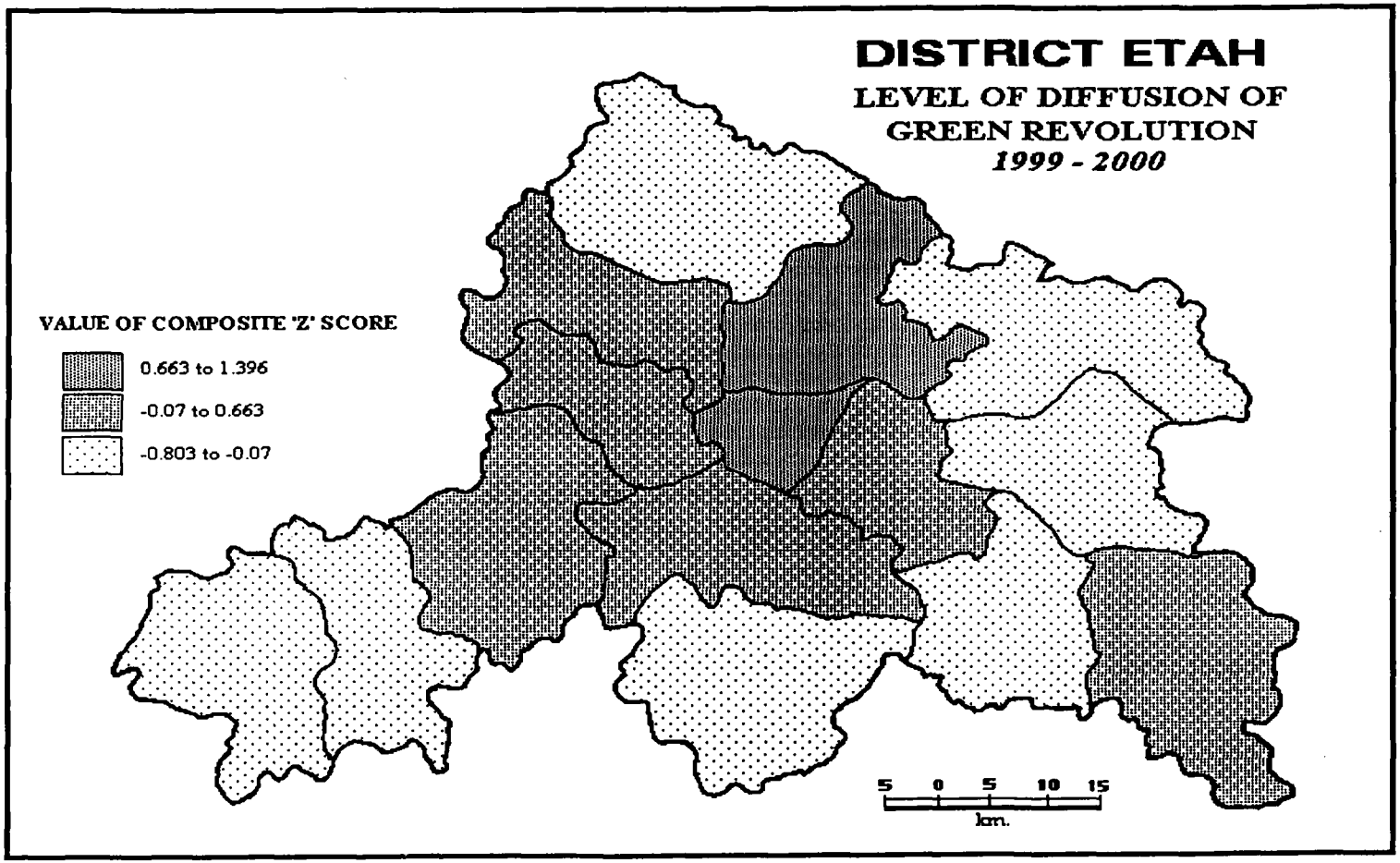

DISTRICT ETAH
LEVEL OF DIFFUSION OF
GREEN REVOLUTION
1999 - 2000
VALUE OF COMPOSITE 'Z' SCORE
0.663 to 1.396
-0.07 to 0.663
-0.803 to -0.07
5 0 5 10 15
km.

Fig – 7.8

HIGH LEVEL DIFFUSION OF GREEN REVOLUTION:

High level of diffusion of green revolution comprises of four development blocks namely Sheetalpur, Marehra, Kasganj ad Awagarh (Fig- 7.7) This high level diffusion of green revolution, during the initial period of the introduction of green revolution, is due to the awareness of the farmers, availability of assured irrigation and socio-economic condition of the farmers in 1975. With the passage of time, after a period of twenty-five –years, the situation have completely changed, because, high level diffusion green revolution blocks decreased from four in 1975 to two in 2000, and these completely replaced by another two development blocks, namely Sahawar and Amanpur, while these blocks were in low level diffusion category in 1975. This speedy, diffusion of green revolution is due to the availability of assured irrigation, good quality of soil, awareness of the farmers and socio-economic transformation of agricultural society.

MEDIUM LEVEL OF DIFFUSION OF GREEN REVOLUTION:

This region of medium level diffusion of green revolution has shown in the figure-7.7 with + 0.663 to –0.07 'z' Score value, comprises of two blocks namely Nidhualikalan and Sirpura in 1975. In 2000, the development blocks under the category of medium level diffusion of green revolution have increased from two blocks in 1975 to six development blocks in 2000. The other blocks added to this category are Marehra, Sheetalpur, Kasganj and Aliganj. Development blocks – Marehra Sheetalpur and Kasganj represents slow rate of the diffusion of green revolution, because these blocks were in the high level diffusion category in 1975. Nidhaulikalan and Sirpura remains its position while Aliganj improved its position from low-level diffusion of green revolution to medium level diffusion of green revolution. The medium category has experienced medium index of literacy, medium level of land holding and the quality of soil too.

LOW LEVEL DIFFUSION OF GREEN REVOLUTION:

The low level diffusion of green revolution having 'Z' scores value less than –0.07 (Fig-7.7), and comprises nine development blocks e.g. Sakeet, Sahawer, Amanpur, Soron, Aliganj, Ganjdundwara, Jalesar, Patiali and Jalesr in 1975. The above analysis shows a positive correlation between the diffusion of green revolution and social awareness, land holding, quality of land, source of irrigation. In 2000, the number of development blocks under the category low level diffusion of green revolution have reduced from nine in 1975 to seven in 2000, namely, Awagarh , Jalesar, Patiali, Jaithra, Ganjdundwara, Sakeet and Soron (fig.7.8).

From the above analysis, it may be concluded that the variation of level of diffusion of green revolution is characterized by the variation in physico-cultural and socio-economic conditions of the region, because it has direct impact on the diffusion of indicators of green revolution .The region which has adopted high level of diffusion of green revolution, is characterized by high irrigation, bigger size of land holding, high literacy, exposure to mass media and social awareness. It is suggested that medium and low level of diffusion region may be brought to the high level diffusion of green revolution provided the high level of irrigation, high literacy exposure to the mass media, availability of better marketing facilities, communication and transportation be made available to the respective region of the study area.

Reference:

1- Fourth five year Plan- A draft outline planning commission, 1966, p 175.

2- Mukerji,B.K., and Chaterji,S.S.:Review of Work done on water requirements of Crops in India, ICAR, 1967, pp 31-47.

3- Vladimir Ignatief and Harold,J. Page, (Eds.): *Efficient Use of Fertilizers* (FAO), Rome, 1966, p 2.

Chapter - 8

Village Studies

VILLAGE STUDIES

Agriculture has dominated the rural landscape and claimed the best part of the cultivators working hours for centuries in Uttar Pradesh as well as in all over India. Even today it dominates the countryside, but the pace of development in agriculture has been a tardy one, inspite of the 75 per cent rural population is engaged in this economic activity. The rural landscape continuously showing characteristic of the oriental view point and now the cropping pattern have totally changed due to the introduction of green revolution. Village is the best unit of study to draw a clear picture of the present agricultural scenario.

The fundamental basis of change in the cropping pattern is not only in the district of Etah but it can also be seen throughout India. The transformation of crops have been accelerated by a revolution in the geography of irrigation, a phenomenal improvement in transport and communication of ideas, a significant accessibility and raising standard of living, They have increased governmental role and state supported research and publicity in agricultural affairs which have brought about a significant changes in cropping pattern and agricultural production. The comprehensive agricultural production programmes have brought about the changes in agricultural structure of the district of Etah. A study on the village level, about the diffusion of factors associated with the change in cropping pattern will form a clear image of cropping pattern in the region under study.

India has initiated the process of planned development right from the inception of first five year plan with a view to bring about a structural

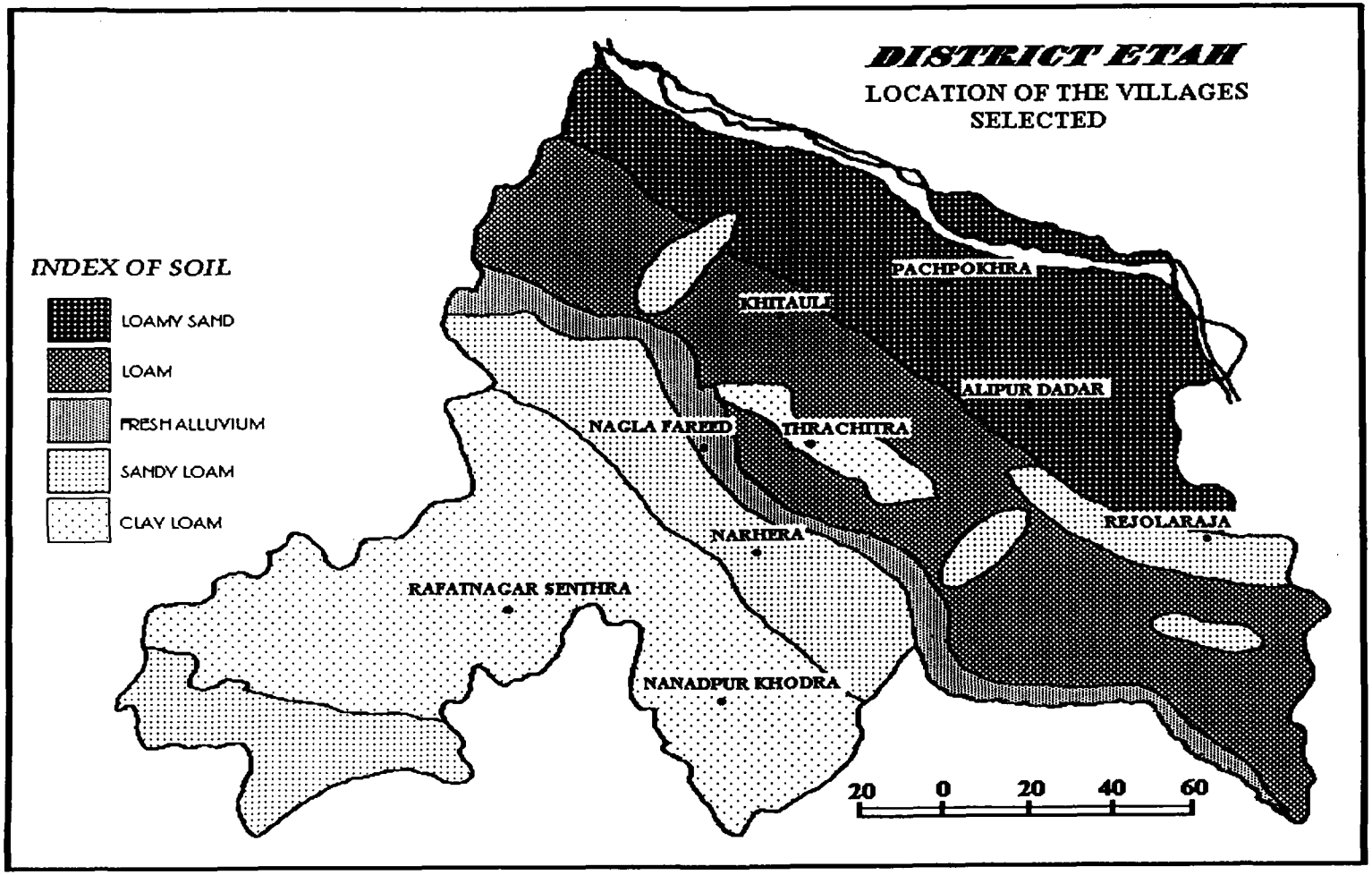

DISTRICT ETAH
LOCATION OF THE VILLAGES SELECTED
INDEX OF SOIL
LOAMY SAND
LOAM
FRESH ALLUVIUM
SANDY LOAM
CLAY LOAM
PACHPOKHRA
KHITAULI
ALIPUR DADAR
NAGLA FAREED
THRACHITRA
REJOLARAJA
NARHERA
RAFATNAGAR SENTHRA
NANADPUR KHODRA
20 0 20 40 60

Fig 8.1

transformation of the economy so as to achieve a high and sustained rate of growth, a progressive improvement in this standard of masses leading to eradication of poverty and unemployment. In order to achieve this objective, the emphasis has kept on changing the cropping scenario and for this govt. has decided to create an appropriate environment of technology especially in case of ~~farm~~ implements irrigation system, improved variety of seeds, and chemical fertilizers ~~but~~ the most important resulting ~~factor~~ is the increase production per hectare. All these factors and associated cropping pattern have been analysed ~~on~~ at the village level. Here, nine villages have been selected for the present study the selection of these villages has been done on the basis of type of soils and proximity of railways and roadways (Fig. 8.1).

SELECTION OF VILLAGES:

The census hand book of the district for the year 1991, provides some basic information relating to individual villages, their total area and area under different crops etc. in selecting the villages following criterion were adopted;

I. Each selected village should belong to a zone of different quality of soil.

II. Selected villages should have a fair representation of the existing cropping pattern.

III. Remoteness and proximity of the villages to the roadways, railways and urban area.

SELECTION OF THE VARIABLES:

Changing cropping pattern is a dynamic aspect. By its definition there are many agricultural conditions and technological aspects which together define the level of change in cropping pattern. Since the purpose of present analyses is to analyse the impact of environment on changing

cropping pattern in the district of Etah at a point of tame. The variables which are selected for the present study are:

I. Agricultural Conditions.

   a. Net Sown Area.

   b. Cropping Intensity

   c. Cropping Pattern.

II. Technological Factors.

   a. Irrigation Facilities.

   b. Consumption of Fertilizers.

   c. Use of Mechanical Appliances.

AGRICULTURAL CONDITION IN SELECTED VILLAGES:

Agricultural conditions in the selected villages have been studied to asses the present cropping pattern on the basis of percentage of the net sown area to the total reported area, intensity of cropping and cropping pattern, and the associated factors which leads to the changes in the cropping pattern e.g. percentage of net irrigated area to net sown area, consumption of fertilizer and mechanical implements etc.

NET SOWN AREA:

The net sown area has unequally distributed in the village. This variation in percentage of the net sown area to the total reported area is due to the physiographical conditions of the villages and the availability of techno- organizational factors. For the study of the area variation in the net sown area three groups have been recognized.

I Areas with high proportion of net sown area

II Areas with medium proportion of net sown area

III Areas with small proportion of net sown area.

Table- 8.1

PERCENTAGE OF NET SOWN AREA IN SELECTED VILLAGES (IN ETAH DISTRICT)

VILLAGES	TOTAL REPORTED AREA	NET SOWN AREA IN HECT.	PERCENTAGE NET SOWN AREA
Khitauli	268.997	251.389	93.45
Alipur Dadar	114.299	100.796	88.186
Nandpur Khodra	130.719	111.989	85.67
Pachpokhra	173.471	143.904	82.95
Nagla Fareed	61.693	50.43	81.8
Thrachitra	434.875	353.00	81.172
Rejola Raja	1450.29	1124.72	77.565
Narhera	143.260	84.676	59.1
Rafat Nagar Shentara	1216.195	715.16	58.80

Source- Office records of district Revenue Office

hectares

Table - 8.2

LEVEL OF NET SOWN AREA IN SELECTED VILLAGES

CATEGORY OF NET SOWN AREA	RANGE IN %	SAMPLED VILLAGES
High Proportion of net sown area	82 to 93.45	Khitauli, Alipur Dadar, Nandpur Khodra, Pachpokhra
Medium Proportion of net sown area	70.55 to 82	Nagla Fareed, Thrachitra, Rejola Raja
Small proportion of net sown area	Below 70.55	Rafat Nagar Shentra and Narhera.

AREAS WITH LARGE PROPORTION OF NET SOWN AREA:

Table-8.1 reveals that the net sown area under this category occupied four villages out of the nine selected villages, i.e. Khitauli, Alipur Dadar, Nandpur Khodra and Pachpokhra. These villages have good quality of soil, well developed canal and tube well irrigation and small land holding. Regional contrasts in the selected villages' pronounced so much that carpet of considerably very high percentages (Khitauli 93.45%, Alipurdadar 88.186 NandpurKhodra 85.67%) of net area sown can be seen in the Table- 8.1.

Factors other than relief, soils, and climate such as techno-organizational, institutional and socio-economic factors, also contribute to the regional contrast in the distribution of net sown area, chiefly by the reinforcing natural environment. This high percentage of net sown area in these villages is more or less stable except in the extreme natural disasters such as hail stone, because all the physical as well as socio-

economic conditions are in the favour of good agricultural conditions such as most fertile alluvial soil of the district, well developed tube-well as well as canal irrigation facilities and proximity to the roadways which provide good transportation system, etc.

AREAS WITH MEDIUM PROPORTION OF NET SOWN AREAS:

The villages, which fall in this category, are Nagla Freed, Thrachitra and Rejolaraja. Medium proportion of net sown area represents 70% to 82% net sown area. No doubt these villages have good quality of soil but less developed irrigation facilities which make the unstable ~~to the~~ percentage of net sown areas. In ordinary sense, the extent of following is primarily determind either by inclement climatic conditions or by ~~jwctvation~~ in canal discharges or frequent canal closers or restricted power supplies to the tube-wells all combinedly lead to inadequate supply of agricultural water ~~inhabiting the magnitude of~~ cultivation. Village Nagla Fareed with 61.645 hectare or reported area has 81.8 per cent net sown area e.g. 50.43 hectare. Nagla Fareed have all favourable condition for the development of agriculture i.e. good quality of soil, well developed tube-well irrigation, ~~the~~ land uses other than agriculture in this village ~~is~~ are very low e.g. in the form of ponds, grave yards and settlement, etc. Thrachira is a second village which falls in the category of medium proportion of net sown area. Thrachitra with 434.875 hectare geographical area have 81.17 percent net sown area i.e. 353 hectare. Being a loamy soil of this village requires well developed irrigation facilities. The fluctuation in the rain fall, irregularities in the discharge of canal water and loamy soil constrain this village to have medium proportion of net sown area. Village Rejolaraja is situated in the *Tarai* region so a large portion of this village is *Tarai* land that is why water logging condition prevails there which results low proportion of net sown area e.g. 77.565 percent or 1124.72 hectare.

LOW PROPORTION OF NET SOWN AREA:

Two villages have been found in the category of low proportion of net sown area, out of the nine selected village surveyed. These villages are Rafat Nagar shentra and Narhera. The main causes of this low proportion of the net sown area in these villages are saline and sandy soils remoteness from the urban area and lower standard of education. The distance from the urban centers constrain to the farmers to use the out dated implement and also fails to use the fertilizer for the improvements of the fertility of soil.

The regional variations in the extent of net area sown are linked with, proportion of waste land, quality of soil, water logging conditions and instability in the rainfall. The regional variations in magnitude of these controls individually or collectively lead to the regional variation in the distributive pattern of fallowing in the agricultural unit where area extent is very limited. The increasing development of irrigation and plant breeding, have made it possible to grow a wide range of crops on different soils. The area under fallow land has declined considerably in the tube-well and canal irrigated areas. An instructive conclusion is that the maximum increase in the net area sown within the cultivated area has occurred in area where radical modifications in physical controls have been initiated and expedited by man, chiefly through the provision of an additional agricultural water supply and improved dry farming techniques.

INTENSIFICATION OF CULTIVATION:

Intensity of cropping refers to the multiple use of agricultural land that is, double or triple cropping systems in the same field and in the same year. The percentage of gross sown area to net sown area gives a measure of index to intensity of cropping. The degree of intensity of

cropping and its spatio-temporal variation is related to the intensity of irrigation, rainfall distribution and soil fertility.

In the quest for a strategy for maximizing agricultural production multiple cropping i.e., raising more than one crop in a sequence in an agricultural year on a unit of crop land (National commission of agriculture, 1976) holds a vast potential in most rural areas of India in view of the prevailing abundance of farm labour, a favourable climate a net sown area being sown more than once. The disparity has widened within the district. The feature strategy should emphasis on a faster growth in the incidence of multiple cropping in areas where it remains low for which purpose regional diagnostic exercises are essential.

The present inquiry aims at analysing the regional variation in the multiple cropping and the role of some important factors responsible for the disparity in it in the district Etah. Multiple cropping is conventionally expressed as cropping intensity in per cent, calculated as follows:

$$\frac{\textbf{Total Cropped Area}}{\textbf{Net Sown Area}} \textbf{ X 100}$$

Indices of cropping intensity have been computed for the 1999-2000 for all the selected villages surveyed. These indices are follows as:

Table- 8.3

CROPPING INTENSITY IN THE SELECTED VILLAGES

NAME OF THE VILLAGE	TOTAL CROPPED AREA	CROPPING INTENSITY
Nandpur Khodra	226.891	202.06
Nagla Fareed	112.567	193.308
Thara Chitra	685.00	194.05
Pach Pokhra	270.445	187.93
Khitauli	433.495	170.4
Alipur Dadr	158.223	156.7
Rejoilaraja	1644.856	146.176
Rafatnagar Senthra	1009.206	141.116
Narhera	117.908	139.096

Source-office Records of District Revenue Office

For the study of areal variation in the intensity of crop, it is grouped into three categories i.e.:

(i) Villages with high intensity of crops

(ii) Villages with medium intensity of crops

(iii) Villages with low intensity of crops

Table - 8.4

LEVELS OF CROPPING INTENSITY IN THE SELECTED VILLAGES

Categories	Intensity	Name of the Villages
High	181-202	Nandpur khodra, Nagla Fareed, Thrachitra and Paochpokhra
Medium	160-181	Khitauli
Low	139-160	Rejolraja, Rafatnagar Santhra, Narhera and Alipurdader

The villages which fall in the category of high cropping intensity have, cropping intensity between 181 percent and 202 per cent of the net sown area. The extent to which cropping has been done on the net area sown is recorded in the table-8.3 exhibiting the contemporary spatial patterns. All the villages (Nandpur Khodra, Nagla Fareed, Thrachita and Pachpokhra) with high intensity of cropping have good quality of soils, good irrigation facilities, use of HYV of seeds and the use of mechanical appliances. Re-sowing of the net area sown in the selected villages depends on human traditions and initiatives, the possibilities of irrigated or dry farming and the extent to which the new farm technology has been adopted. These controls are subordinate to limitations imposed by the scarcity of agricultural water and the soil problems till they are modified by manmade frame. The paucity of cultivated area, the high cultivator density and the extent of tube-well irrigation in Nandpur Khodra, Nagla Fareed, Thrachitra and Pachpokhra have caused a significant shift in cultivation from single cropping to double cropping region. In addition to the alluvial soils these areas have probably been farmed more intensively then other parts of the district. The intensity of farming in a subsistence farm economy is often determined not only by the ecological and socio-economic influents but also by the intensity of farm workers because a denser farm worker's base must tend to produce smaller individual operational holding and at the same time a greater abundance of a farm labour, thus inducing more intensive production from the land.

Only one village in the category of medium cropping intensity i.e. khitauli, while all the favourable conditions high irrigation density and good quality of soils for the high cropping intensity, but low agricultural labour density and the attitudes of the farmers have stand this village in the category of the medium cropping intensity. Four villages fall in the category of low cropping intensity namely, Rejolaraja,

Rafatnagar Santhra, Narhera and Alipurdadar. The cropping intensity in these villages has been recorded as: Alipurdadar 156.7 per cent of the net sown area, Rejolaraja 146.176 per cent, Rafatnagar santhra 141.116 per cent and Narhera 139.096 per cent of the net sown area.

The most direct explanations of the variation in the area distribution of cropping intensity index have of course reference to the effect of irrigation intensity, cultivators density, the nature of soil, the rainfall characteristics and the size of the operational holdings. The cropping intensity index in the selected villages varies from 139.096 per cent to over 202 per cent, exhibiting a greed regional disparity depending on the magnitude of areal variability in influents enumerated in the foregoing discussion.

Realising the gravity of the situation i.e. low and moderate magnitude of the intensity of cropping (Table- 8.4) and the possibilities of the extension of double cropping in the most part of the district, the district should meet the serious challenge of the under-use of the net area sown.

CROPPING PATTERN:

To assess the cropping pattern, only five major crops have been taken. Table-8.5 Shows the village wise cropping pattern wheat, pearl millets and rice are three major crops each respectively accounting for 37.82, 13.53 and 12.59 per cent of the gross sown area. Maize and Pulses are also important crops, which covers 8.055 and 4.716 per cent of the gross sown area respectively. Other crops cover remaining 23.28 per cent of the gross sown area.

WHEAT:

Table-8.5 shows wheat is the most important crop in all villages and has first rank. Three groups of factors that largely determine

whether it can be economically produced in a given area, and therefore controls its distribution, are agronomic, social and economic. Wheat has a wide climatic and soil adaptation range: Firstly, the more temperate conditions wheat prefers are found all over the region. Secondly, the crop is grown in a variety of soils ranging from stiff clay to sandy loam; and thirdly, relatively low rainfall of 250 mm on the crop will sufficient. The crop generally to be irrigated to get a good harvest as the rainfall at that time of the year is not adequate. Therefore, the bulk of the wheat hectarage has to be irrigated, which exhibits the positive relationship between wheat and irrigation hectare age.

Table - 8.5

CROPPING PATTERN IN THE SELECTED VILLAGES

Name of the Village	Wheat % of G.S.A.	Pearl millets % of G.S.A	Rice % of G.S.A.	Maize % of G.S.A	Pulses % of G.S.A.
Khitauli	44.84	13.93	12.08	16.03	7.06
Thrachitra	36.49	23.33	5.69	7.19	3.78
Rejola Roja	44.10	16.21	20.32	4.37	1.9
Pachpokhra	46.84	8.42	14.055	20.82	1.34
Nandpur Khodra	34.37	13.67	6.56	4.08	6.02
RafatNagar Senthra	4082	8.12	9.42	6.46	13.3
Narhera	51.44	1.01	2.94	3.29	2.05
Nagla Fareed	31.44	3.25	31.72	9.20	2.05
Alipur Dadar	28.94	5.76	15.12	15.24	1.2

Source- Office records of district Revenue Office.

G.S.A.-Gross Sown Area

It constitutes an important part of the village's trade and commerce. It is also the staple food crop of the region. It is primarily a cash crop in the wheat basket of the villages in which wheat covers more than 40% of the gross sown area. The villages which have the highest acreage of the wheat are Narhera with 51.44 per cent of its gross sown area and followed by Pachpokhra with 46.84 per cent of its gross sown area, Khitauli, Rijola Roja and Rafatnagar Senthra have 44.84 per cent, 44.10 per cent and 40.82 per cent wheat acreage of the gross sown area respectively. The lowest percentage of the wheat acreage has been recorded in the village Alipurdadar i.e. 28.94 per cent of its gross sown area in-spite of this wheat is the first ranking crop of this village.

PEARL MILLET:

Pearl millet is the second important crop. Table- 8.5 shows, pearl millets have recorded second rank crops in two villages, namely Thrachitra and Nandpur Khodra with 23.35 and 13.6 per cent of the gross sown area respectively. In the villages: Khitauli, Rejola Raja and Rafat nagar Senthra, pearl millets has been recorded as the third rank crop in terms of acreage. Village Khitauli have 13.93 per cent of its gross sown area, Rejola Raja 16.21 per cent and Rafatnagar Senthra have 8.12 per cent of its gross sown area. The villages, Alipur Dadar, Nagla Fareed, Narhera and Pachpokhra have been recorded as the fourth rank crop. In Bahadurnagar and Narhera villages, the percentage of pearl millets to the gross sown area is very less i.e. 3.25 per cent and 1.01 per cent respectively (Table- 8.5).

RICE:

The rice acreage is limited by rainfall. The rice crop requires in most instances a relatively high atmospheric humidity, high temperature and a well distributed rainfall between 1250 mm and 1500 mm during the growing season within the area of production and in the area of streams

and canal distributaries furnishing water for irrigation. Rainfall for the rice crop is not sufficient in the region the most important factor for the rice cultivation in the region is the assured developed supply of agricultural water through the canals and tube-wells.

Rice is the third most important crop of these villages as an average, while in the village of Nagla Fareed, Rejola Raja and Pachpokhra is the second ranking crop with 35.8 hectares or 31.72 per cent of its gross sown area, 333.189 hectares or 20.32 per cent of its gross sown area, and 38.012 hectares or 14.055 per cent of its gross sown area (Table- 8.5) The lowest percent of rice acreage has been recorded in the village of Narhera and Thrachitra which have 2.9 per cent of its gross sown area and 5.69 per cent of its gross sown area respectively.

MAIZE:

Maize cultivation is by for the most important and fourth extensive food grain crop of these villages. Maize is an ideal economic and productive crop of the village economy. Maize is the second ranking crop of the village Pachpokhra and Khitauli i.e. 56.315 hectare or 20.82 per cent and 69.498 hectare or 16.03 per cent of the gross sown area respectively. Maize is generally concentrated in the villages which have adequate irrigation facilities due to the uncertainty in rainfall.

Table- 8.5 shows that the village Alipurdadar, have 15.24 per cent of the gross sown area or 24.199 hectare, Nagla Fareed 9.2 per cent or 9.66 hectare Narhera 3.29 per cent or 3.88 hectare and Thrachitra have 49 hectare or 7.15 per cent of the gross sown area.

PULSE:

Pulses crop is often largely cultivated as mixed crop along with millets crop in the villages under study. Cultivation of pulses does not require much care and investment and they are grown in poor soils.

Pulses on an average accounted for 4.09 per cent of the grossed cropped area of all the villages under study.

Table 8.5 shows during the period of study i.e. 2000; a large difference has been recorded in the acreage of pulses. Village Rafatnagar Santhra has been recorded 134.63 hectare or 13.3 per cent of its gross sown area, village Khitauli 26.284 hectare or 6.06 per cent and Nandpur Khodra 13.6 hectare or 6.02 per cent of its gross sown area. While the villages Rejola Raja, Pachpokhra and Alipur Dadar have devoted very small proportion for the pulses cultivation i.e. 1.96, 1.34 and 1.2 percent of its gross sown area.

TECHNOLOGY:

The degree of 'technification' is the basis for the existing level of cropping pattern, if new land is to be brought under the multiple cropping. If the conflicting demand of food and cash crops are to be resolved by making readjustment in the cropping pattern and if the quality of the agricultural products is to be improved, more technification in the agricultural sector required. In the modern usage, 'technification' covers two aspect of farm technology, viz. biological and mechnical; the twine influents influence the progress in farm production and are the primary base of the Green Revolution[1].

The development of high yielding verities, the improved methods of crop fertilization and the discovery and controls are the progressive biological techniques that increase the production per hectare. The, second but significant value are the utilization of new sources of mechanical power such as tractors, cultivators and more efficient iron based farm implements. The most important technological factor of agriculture is the irrigation facility which assists to all the farm technology for batter result.

In the selected villages, it is expedient to examine the component of the green revolution, i.e. intensity of irrigation, use of fertilizers and use of mechanical implements. Natural agrarian structural and cultural pre-conditions prevailing in the region determine the extent to which farm mechanization can be extended. The major part of the land is a level one, suitable for mechanized farming albeit small size of land holding limits to the degree of mechanization.

IRRIGATION:

In a region like district of Etah where natural water is not sufficient for the use of improved seeds and chemical fertilizers, the importance of irrigation has increased.

Irrigation in the selected villages is provided through two different sources, firstly by chennalizing surface water from rivers, wells and other sources and secondly by taping the sub-soil water through wells and tube-wells. Table-8.6 shows the total irrigated area as the percentage from the gross cropped area and the percentage of irrigation by different sources in the villages during the period of survey (2000). All the villages have been assigned high, medium and low grades in terms of irrigation availability.

On the basis of table-8.6 four villages fall in the categories of high irrigation availability, namely Pachpokhra, Nagla Fareed, Khitauli and Thrachitra. Medium availability has been recorded in the villages Nandpur Khodra, Alipur Dadar, and Narehra. Low irrigation spread is seen in the villages; Rafatnagar Santhra and Rejolaraja.

Table-8.6 shows the position of irrigation by different sources in the villages. Canal irrigation is extensive in the villages; Nagla Fareed which irrigates about 96% of the total irrigated area and followed by Khitauli and Alipur Dadar with 83% and 82.35% of the total irrigated area by canal respectively. In other villages, namely Rafatnagar Santhra,

Thrachitra and Pachpokhra where the canal irrigation covers 77.1 per cent, 75.5 per cent 44.9 per cent of the total irrigated area respectively. The villages Rejolaraja, Narhera and Nandpur Khodra have no canal irrigation facilities.

Tube-well is the second important source of irrigation not only in the selected villages but in the whole of the district Etah. The village Rejolaraja has 84.96 per cent of the total irrigated area under the tube-well irrigation which is the highest proportion under tube-well irrigation among all the villages. The villages Nandpur Khodra and Narhera cent per cent depend on tube-well for irrigation.

Table- 8.6

AVAILABILITY OF IRRIGATION FACILITIES IN SELECTED VILLAGES

NAME OF THE VILLAGE	PERCENTAGE OF GROSS SOWN AREA IRRIGATED	PERCENTAGE SHARE OF CANAL IRRIGATION	PERCENTAGE SHARE OF TUBE-WELL IRRIGATION.	PERCENTAGE SHARE OF OTHER SOURCES
Khitauli	91.4	83.1	16.9	-
Thrachitra	90.1	75.3	24.6	-
Rejola Roja	65	-	84.96	14.04
Pachpokhra	94	44.9	55.09	-
Nandpur Khodra	83.08	-	100	-
RafatNagar Senthra	72.58	77.1	22.9	-
Narhera	77.15	-	100	-
Nagla Fareed	93.16	96	4	-
Alipur Dadar	77.03	82.35	17.6	-

Source- Office Records of District Revenue office

USE OF FERTILIZERS:

Increasing food production by the area increasing method is limited ~~to some extend~~ in the region except perhaps marginally, as all land which is suitable for cultivation, and much that is only marginally so, has already been brought under the plough. Fertilizers play a very important role for the development of agriculture. Table-8.7 shows village-wise consumption of fertilizers in Kg. per hectare.

Table- 8.7

CONSUMPTION OF FERTILIZERS IN THE SELECTED VILLAGE

NAME OF THE VILLAGE	CONSUMPTION OF FERTILIZERS IN Kg. PER HECTARE
Khitauli	175
Thrachitra	160
Rejola Roja	133
Pachpokhra	185
Nandpur Khodra	190
Rafatnagar Senthra	120
Narhera	125
Nagla Fareed	110
Alipur Dadar	109

Source- Office records of district Revenue Office

During the survey in 2000, a wide difference has been recorded in the consumption of fertilizers. Nandpur Khodra has the highest consumption of fertilizers i.e. 190 kg. per hectare and followed by Pachpokhra with 185 Kg. pert hectare and Khitauli 175 Kg. per hectare. The lowest consumption of fertilizers has been recorded in the village Alipur Dadar i.e. 109 Kg. per hectare. The consumption of fertilizers and the cropping intensity have positive relationship i.e. high consumption of fertilizers leads to the high cropping intensity.

AGRICULTURAL IMPLEMENTS:

Agricultural implements and machinery are strong inputs for better productivity of land because their use increases the farm efficiency, saves time and minimize the production cost. The type of machinery changing fast, the older one replaced by better performing new ones to further increase in farm efficiency and farm output. It is therefore; better to know the position of the farm machinery in the selected villages.

Table- 8.8 shows number of tractors per hundred hectare of net sown area. The highest number of tractors (4.00) per hundred of hectare are recorded in the village Khitauli. In this village the percentage of net sown area is also highest (Table- 8.1). The village Khitauli followed by Nagla Fareed with 3.96 Nandpur Khodra with 3.57 and Thrachitra with 3.399 tractors per hundred of hectare. These villages also have high percentage of net sown area i.e. Nagla Fareed 81.8 and Nandpur Khodra 85.67 (Table-8.1), high cropping intensity i.e. Nandpur Khodra 202.06, Nagla Fareed 195.508 and Thrachitra 194.05 per cent (Table- 8.3) and high level of fertilizer consumption i.e. Nandpur Khodra 190 Kg, Nagla Fareed 175Kg. and Thrachitra 175Kg. per hectare (Table-8.7). The lowest level availability of tractors per hundred of hectare has been recorded in the village Narhera i.e. 2.36 tractors. In this village the cropping intensity

is also low i.e. 139 per cent and percentage of net sown area is low too i.e. 59.1 percentage of the total reported area (Table- 8.3).

Table- 8.8

AVAILABILITY OF TRACTORS IN SELECTED VILLAGES

NAME OF THE VILLAGE	TOTAL No. OF TRACTORS IN EACH VILLAGE	No. OF TRACTORS PER HUNDRED OF HECT.
Khitauli	10	4
Thrachitra	12	3.99
Rejola Raja	30	2.66
Pachpokhra	4	2.97
Nandpur Khodra	4	3.57
Rafatnagar Senthra	23	3.21
Narhera	2	2.36
Nagla Fareed	2	3.96
Alipur Dadar	3	2.97

Source: Based on the field survey

Thus it may be concluded that the extent to which the production potential of the soils can be fully exploited, is dependent not only on the depth and quality of tillage, the extent of the application of fertilizers, the intensity of irrigations, etc. but also on adherence to minimum timing of tillage operations. In the region of sub-tropics with well-defined wet and dry seasons and in the semi-arid regions, the most favourable time for tilling are concentrated into such short periods that adherence to them is possible only with the help of powerful mechanical draft force which must be available readily if full advantage to be taken of the potential yield of the soils. The effect of mechanization in this case is primarily to raise yields by speeding up the work to conserve the soil moisture. For this purpose, an efficient draft power is needed in rain fed as well as in irrigated agriculture. The extra power, speed and persistence of tractor enable farm operations to be executed rapidly. In this way mechanization can be used to create throughout the year favourable growing conditions. Further, mechanical power has enabled the operation for reclamation of heavier soils to be carried-out, resulting in appreciable contraction in the cultivable waste land.

The personal experience of the author confirm the several consequences of mechanization first, the replacement of bullocks by tractors has released land formerly devoted to fodder, whatever fodder is raised on farm is traded except for a very small quantity reserved for milch stock; secondly mechanization, has made it easier to cultivate and colonise the heavy soils; thirdly, mechanization saves labour and makes it more productive; fourthly, it accentuate the differences in levels of agricultural productions at farm as well as regional level. In this way, mechanization leads to change in the cropping pattern.

CORRELATIONS:

In the selected villages cropping intensity index value showed a spatial variation from 202.06 per cent in the village Nandpur Khodra to 139.06 per cent in the village Narhera and the simple correlation matrix (Table- 8.9) revealed the highest degree of positive correlation (r =0.8616) between the cropping intensity index and the intensity of irrigation followed by number of tractors intensity (r =0.6555), fertilizers consumption (r = 0.566), perlmillet area (r = 0.3373) and maize area (r = 0.2329). Under the new technology, high degrees of complementarity exist among these factors and it reflects clearly in the district Etah. Negative correlation has been recorded between the cropping intensity index and wheat acreage (r = -0.44) and followed pulse acreage (r = -0.203). The negative correlation is because of an inverse relationship between these and multiple cropping.

The study indicates that the spatial change in pulse acreage have no impact on the cropping pattern. The highest influencing factor to the cropping pattern has been identified as the irrigation and followed by the fertilizers consumption and the availability of tractors.

Table- 8.9

SIMPLE CORRELATION TABLE

	y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
Y	1									
X_1	0.64**	1								
X_2	0.148	0.566**	1							
X_3	0.44**	0.86**	0.578**	1						
X_4	0.143	0.65**	0.275*	0.578**	1					
X_5	-0.66**	-0.44**	0.29*	-0.13	-0.47**	1				
X_6	0.23*	0.33*	0.527**	0.181	0.236*	-0.078	1			
X_7	0.25*	0.23*	0.236*	0.463**	0.236*	-0.02	-0.10	1		
X_8	0.34*	0.188	-0.38**	0.202	0.337*	-0.38**	-0.24*	0.239*	1	
X_9	-0.55**	-0.20	0.060	-0.43*	0.281*	0.025	0.130	-0.249*	-0.32*	1

*= Significant at 95%

**= Significant at 1%

Y – Percentage of Net Sown Area

X_1– Cropping Intensity Index

X_2 – Fertilizers Consumption

X_3 – Irrigation Intensity

X_4 – Tractors Intensity

X_5 – Percentage Area of Wheat

X_6 – Percentage Area of Pearl-millet

X_7 – Percentage Area Maize

X_8 – Percentage Area of Rice

X_9 – Percentage Area of Pulse

Pearl-millet cropped area also has a positive correlation with the cropping intensity because of its direct contribution to the gross cropped area because it is sown as a rain fed crop. Pearl-millet, maize and rice have high influence on the cropping pattern with a positive correlation between percentage of net sown area and rice acreage (r =0.349), maize acreage (r =0.25) and pearl-millet (r =0.237). Irrigation intensity is remains a highly influencing factor to the cropping pattern with the positive correlation (r =0.44) between irrigation intensity and net sown area (Table- 8.9).

Chapter - 9

Conclusions & Suggestions

CONCLUSION AND SUGGESTIONS

Cropping pattern in the district of Etah has evolved within the environmental framework in which geographical factors like land forms soil and climate have played the vital role. Whether a land would be under agricultural use or not is in the first place a function of environmental factors as elaborated in the opening chapter on physical setting; landforms, drainage, climate and other factors namely socio-economic operate to finally determine the pattern of agricultural land use.

The fact that the region under study (District Etah) is a part of the Ganga-Yamuna *doab* which is a vast alluvial plain with a very gentle slope from north west to south east well drained by the river Ganga, Kalinadi, Burhganga, Isan and the Rind makes for an ideal setting for agricultural activities in the district.

Land formation in the district Etah is another element which has a good deal of bearing on the land use and agricultural pattern of the area. There are four well defined regions in the district Etah. The *Tarai* is stretches from the bed of the Ganga to the old high bank of the Ganga. The soils throughout the district are alluvial in character with the difference that they have a large admixture of vegetable matter. Even where the proportion of sand is high, they are soft and resemble rather artificial soils, the composite of garden than natural earth. The most valuable of the *tarai* soil is the rich soft loam found along the bank of the Ganga, Similar but less valuable soil is found with along the edge of the Burhgarge (old bed of the Ganga). Central *doab* comprises the portion of

The character of the soil in this tract depends largely upon the distance from the kalinadi and old high bank of the Ganga. The bank of the river in this tract are marked by a belt of sand and it is well marked characteristics that whenever they approach one another, these stretches out as though to join hands forming an almost continuous deposits of sand from one river to other. Where on the contrary, they diverge, the sand seems to shrink in and the centre of the tract is occupied by a level plain of loam and *usar* elsewhere the surface is uneven sand being pitted with hollows and depression in which water collect giving rise to a little loamy soil.

The Kalinadi valley on the southern bank and the eastern half of the northern bank of this descent is almost everywhere gradual. But in the western half of the northern bank, the descent in many places is sudden, often with a kind of a steppe between the crest and valley bottom. The soil of these steppes is hard sandy yet fertile. However the central part is inferior to the rest of the valley, if raised it is sandy and if low line it is infected with *reh*.

Southern tract, the tract south of the Kalinadi comprises Jalesar, particularly the whole Marehra and east Sakeet, two third of pargna Sonhar and a portion of Bilram. The tract is distinguished by the absence of sandy soil, and is also the most stable. The prevailing soil is good loam. The stiffest soil is in the north which followed by good loam and then by lighter loam. In the extreme south west, however the level sinks to a marked degree increasing materially the cost of raising water.

As a consequence of these differentiations in land formations land use and agriculture pattern are affected.

Soils of the district of Etah differ considerably and their role in determining the land use and cropping pattern is quite noticeable. Sandy clay along river courses and of fine silt in level parts, often there are

clay along river courses and of fine silt in level parts, often there are poorly drained which result in formation of a thin salt crust on the surface, water logging is not common. Generally, the soils of Etah are of four type i.e. loamy sand, loam, clayey loam and sandy loam. The agricultural activities are dominated in every where except in the patches of *usar* and *kettory* land.

Loamy soils are extensively used, grasses and shrubs cover varied dark loamy soils where they are thin. Where these soils are deep they use very productive and support a variety of food and Cash crops like wheat, barley, maize, millet, rice and sugarcane. Sandy loam is another type of soil found in the Kalinadi catchments area. Such soil is highly porous and bears a thirsty appearance but with irrigation facilities available, it turns into productive lands. These soils are often deficient in organic matter and in mineral nutrient. This variety of soil results in a cultivation of variety of crops coarse grains on poor soils and while wheat barley, maize and rice on a better soils.

Loamy soils (*Matiyar*) is another variety of soils in the region under study and with their poor water holding capacity and acidic reactions they are not commonly suitable to agriculture and where they are under cultivation coarse grains like sorghum, pearl millet, maize and pigeon pea grow wheat and barley are grown where irrigation facilities are available.

Clayey loam is yet another type of soil in the district. These soils have the tendency to be become hard and compact and yield to plough with difficulty. In these soils sugarcane, wheat, gram and maize are generally grown. It can now be said about the soils that they have direct influence in determining the land use and the cropping pattern.

The role of climate influencing the land use and cropping pattern, is too well known. It plays a significant role in the district Etah also. The

three seasons of the district Etah- the cold (November to February) with occasional rain, the hot season (March to mid June) with a little or no rain and the rainy season (mid June to October) with heavy rain, bring their influence to bear upon the cropping pattern of the district Etah. In winters *rabi* crops mainly, wheat, barley, gram. Peas etc; are grown in the rainy season *Kharif* crops, maize, millet, fodder crops, sugarcane, etc. are grown. In the hot season generally sowing does not take place. Amongst the climatic elements, rainfall has a pronounced influence on the cropping pattern. In the district Etah, where, the rainfall in lower wheat cultivation is followed by the pearl millets and rice, while in the strips along the canal pearl millet gives way to rice.

Landforms, drainage, soil, climate are the basic environmental factors which sometime separately and sometimes together determines the cropping pattern in the district. But in the present scientifically advanced world there are no necessities everywhere are possibilities, it means man through his technical skills break the natural barriers through the development of irrigation facilities, mechanical appliances, use of fertilizers, recovering of sodic or *usar* land, etc.

The district Etah is one of the most fertile districts of Uttar Pradesh where the new technology of agricultural development was initially introduced in 1970. Since then this district has undergone tremendous changes in the field of agriculture. There has been an increase of net sown area from 302495 hectare in 1975 to 310713 hectare in 1999-2000, Gross cropped area from 446857 hectare to 534051 hectare gross irrigated area from 273202 hectare in 1975 to 412719 hectare in 2000. Fertilizers consumption (NPK) has increased from 23.73 kg per hectare in 1975 to 128 kg, per hectares in 2000. The shallow pump sets per thousands of hectares of net sown area have increased from 36 in 1975 to 215.9 in 2000. The numbers of tractors have gone up to 2.73 per thousand of hectare and 12.6 in 2000. These figures convincingly make

Etah district one of the most agriculturally progressing districts of Uttar Pradesh. However, the cropping pattern has not been uniform throughout the district. Hence a modest attempt has been made to asses the changing cropping pattern of the Etah district at the block level for the years of 1975-2000.

The trends in the land use is that more and more land is brought under the plough, more forest land, pasture and grazing land is being deprived of its vegetative cover. More land is coming indiscriminately under industries and urban activities. Another trend is that with the rise of technological and scientific level of development, those lands which were considered useless are being reclaimed and being brought under agriculture. Soils which were considered unfit are enriched and are ploughed.

The present study has been ~~one of the~~ probing in to dynamic competitive relations of crops in the total crop land since the approach has been through analysing individual crops and crop combination in terms of their relative land occupancy strength. An analysis of the data shows that from time to time changes have taken place in the cropping pattern of the area due to one or the other factors the study spread into two phase i.e. before the introduction of green revolution and after the introduction of green revolution, has established some definite lines of approach to the present cropping patterns which have evolved during the period under study. In many cases, it has been observed that change has been brought about by economic consideration, e.g. low return giving crops (coarse grain crops) being replaced by high return giving crops wheat, rice and sugarcane in the area where irrigation facilities are available. It has been observed that in the district Etah the number of crops included in the combination is fairly large and the cropland use diversity quite high.

The present study relating to the changing pattern of crop land use over a period 1950-65 and 1975 to 2000 reveals that wheat has emerged as the first ranking crop in the whole of the district of Etah. This crop has a good share in the combination of area. As it is the staple food crop

of not only of the district Etah but whole of the western Uttar Pradesh. Majority of the population prefers to eat wheat with the result the area under wheat has increased gradually. Yield per hectare has also increased with the help of irrigation facilities, and chemical fertilizers. Prior to introduction of green revolution, more area was given to millets and gram in the district but with the improved economic conditions of the forming community, wheat being a better food crop has become the main diet of the majority of the population. Data reveals that oil seeds, pulses, tobacco, potatoes gained importance in the period after introduction of green revolution, and for the first time tobacco ranked third in the development block of Aliganj. This development block has very much specialized in the cultivation of tobacco fetching good returns.

According to the present study, maize crop is becoming an important crop in the block of Jaithra, Marehra, Patiali, Sirpura, Sheetalpur and Soron, developed irrigation facilities, improvement in the regular supply of manure and chemical fertilizers have helped in the increase of maize cultivation. The increasing market value of superior quality of maize has also been responsible for increase in the cultivated area of maize. Pearl millet remains the second raking crop in most of the development block, Kasganj, Jaithra, Aliganj, Jalesar, Patiali,Soron, Marehra and Nidhaulikalan, due to the quality of soil i.e. Sandy soil. Adequate irrigation facilities and attracting market values provide incentives for increase in the cultivated area. The cultivated area of rice has increase in the development block of Sakeet, Amanpur, Jalesar, Ganjdundwara, Patiali, Sirpura and Sheetalpur, present reveals that rapid rise in urban population in the district Etah calls for an increase in the production of wheat, rice, maize, peas, barley and oil seeds, but wheat has got ascendancy over all the other crops since 1970 because the introduction of high yielding varieties of this crop and the development of supporting factors i.e. irrigation, mechanical appliances

and fertilizer which help to mature in a very short period with high production per hectare. One important thing to note here is that the sugarcane acreage decreasing day by day since 1990 because of the delay of payments by the factory owners. Tobacco has not been so important crop in the cropping pattern of the district Etah but the development block of Aliganj have third rank in its cropping pattern.

An interesting feature emerges from the present study is that the size of land holding being small the farmers are generally interested in producing food grains for their requirements. They would go in for cash crops only after they met their requirements of food grains. It is true that the agriculture of the district Etah being of subsistence type the farmer's community first concern is to cultivate grain crops than cash crops. Thus the need for subsistence crops has traditionally dominated the cropping pattern followed by small farmers. But his marginal need for money can not be less than that of the large farmers. The introductions of green revolution technology make easy marginal adjustment in their crop pattern to maximise their income.

The fragmented and uneconomic size of land holding have brought about just agriculture deterioration at the same time have aggravated poverty of formers. Another drawback in the small size of land holding is that it ~~initiate against~~ the use of farm machinery e.g. harvesters etc. from the present study it is gathered that the farmers ~~like that~~ the combination of crops which ~~would~~ ensure him maximum income. The relative profitability per hectare is the main consideration which influences the cropping pattern. So the farmer is influenced in the choice of his crops by the consideration which relates to the price parities between different commodities or maximization income per hectare which in turn effect to the coarse gains.

It has been realized that the presence of saline salt in soil affect the cropping pattern in the region to a considerable extent. If some steps are

taken to grow leguminous crops, these crops then will help in neutralising the salt and in the recuperation of soil fertility. Reclamation work should be undertaken by the govt. agencies.

Another factor which requires some consideration is that the soils in the entire region are generally deficient in nitrogen and therefore besides applying nitrogen through chemical manures, some leguminous crops, which instead of depleting soil fertility, help in increasing nitrogen in sufficient quantity. In addition to this sun hemp and *Dhencha* are the two important crops which can be cultivated in all adverse conditions of soil and climate.

The structure of cropping pattern in whole of Uttar Pradesh in general and in the district Etah in particular is based on adopting trial and error methods, and hence unscientific .in the present set of physical and cultural environment, some suitable areas for cultivation of remunerative crops could be explored. Besides multiple cropping systems under proper guidance of agricultural experts can be adopted. At least four crops such as wheat, green gram, maize and potato can be grown in the same year from one field. Although the multiple cropping systems are exhaustive, proper watering and manuring can make it possible.

Examining the various factors influencing cropping pattern, it has been observed that besides the physical and socio economic factors, have greatly influenced the cropping pattern in the area where least consideration in given to the suitability of the soil for a particular crop. In the light of the present study it may be remarked that the area needs a detailed survey of the soil, so that the new cropping pattern could be evolved which may ensure batter prospects for an overall improvement in the agricultural economy of the area.

Appendix

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

SORON

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	25603	39346	153,68	817	2,0764		9693	24,635		975	2,478		8383	21,306		4630	11,767	
1980	25301	40054	158,31	1049	2,619	28,397	10077	25,159	3,9616	1182	2,951	21,231	8821	22,023	5,2249	4653	11,617	0,4968
1985	23788	40421	169,92	992	2,4542	-5,4337	11492	28,431	14,042	1532	3,7901	29,611	8266	20,45	-6,2918	4915	12,16	5,6308
1990	24713	42021	170,04	597	1,4207	-39,819	13052	31,061	13,575	1432	3,4078	-6,5274	7758	18,462	-6,1457	6314	15,026	28,464
1995	29365	47195	160,72	1078	2,2841	80,57	16837	35,675	28,999	1154	2,4452	-19,413	7999	16,949	3,1065	6704	14,205	6,1768
1999	24533	48866	199,18	1078	2,206	0	17404	35,616	3,3676	1103	2,2572	-4,4194	8910	18,234	11,389	8093	16,562	20,719

SAKEET

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	20560	29851	145,19	2538	8,5022		11812	39,57		1159	3,8826		3265	10,938		3999	13,397	
1980	19615	30387	154,92	3259	10,725	28,408	12272	40,386	3,8943	1385	4,5579	19,5	3434	11,301	5,1761	3977	13,088	-0,5501
1985	22133	30521	137,9	3193	10,462	-2,0252	12636	41,401	2,9661	1523	4,99	9,9639	3216	10,537	-6,3483	3930	12,876	-1,1818
1990	23564	34933	148,25	4402	12,601	37,864	16115	46,131	27,532	1952	5,5878	28,168	2520	7,2138	-21,642	3265	9,3465	-16,921
1995	24254	39573	163,16	4968	12,554	12,858	14653	37,028	-9,0723	1574	3,9775	-19,365	2595	6,5575	2,9762	3466	8,7585	6,1562
1999	24705	38403	155,45	5295	13,788	6,5821	15145	39,437	3,3577	1386	3,6091	-11,944	3505	9,1269	35,067	4044	10,53	16,676

AMANPUR

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	16908	28563	168,93	1360	4,7614		7530	26,363		639	2,2372		6480	22,687		3980	13,934	
1980	16769	29077	173,4	1757	6,0426	29,191	7822	26,901	3,8778	793	2,7272	24,1	6821	23,458	5,2623	3968	13,647	-0,3015
1985	16521	29559	178,92	1663	5,626	-5,35	8553	28,935	9,3454	808	2,7335	1,8916	5919	20,024	-13,224	2768	9,3643	-30,242
1990	16909	30541	180,62	1860	6,0902	11,846	9272	30,359	8,4064	975	3,1924	20,668	5081	16,637	-14,158	3524	11,539	27,312
1995	16814	32795	195,05	3800	11,587	104,3	11047	33,685	19,144	786	2,3967	-19,385	5234	15,96	3,0112	3741	11,407	6,1578
1999	15906	32861	206.59	3810	11,594	0,2632	11418	34,746	3,3584	985	2,9975	25,318	3874	11,789	-25,984	3727	11,342	-0,3742

JAITHRA

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	23630	33872	143,34	1314	3,8793		11475	33,878		680	2,0076		9454	27,911		3433	10,135	
1980	23359	34488	147,64	1688	4,8945	28,463	11926	34,58	3,9303	826	2,395	21,471	9948	28,845	5,2253	3012	8,7335	-12,263
1985	23474	34303	146,13	2079	6,0607	23,164	13553	39,51	13,642	1087	3,1688	31,598	7432	21,666	-25,292	3060	8,9205	1,5936
1990	23519	36015	153,13	1892	5,2534	-8,9947	14308	39,728	5,5707	995	2,7627	-8,4637	7127	19,789	-4,1039	4291	11,914	40,229
1995	24448	38731	158,42	1880	4,854	-0,6342	15786	40,758	10,33	528	1,3632	-46,935	7340	18,951	2,9886	4556	11,763	6,1757
1999	23592	40048	169,75	2004	5,004	6,5957	16316	40,741	3,3574	761	1,9002	44,129	8111	20,253	10,504	4627	11,554	1,5584

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

JALASER

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	22875	34100	149,07	2228	6,5337		13080	38,358		2522	7,3959		6982	20,475		730	2,1408	
1980	22954	34808	151,64	2861	8,2194	28,411	13589	39,04	3,8914	3031	8,7078	20,182	7346	21,104	5,2134	720	2,0685	-1,3699
1985	23366	35326	151,19	1592	4,5066	-44,355	11942	33,805	-12,12	3584	10,146	18,245	6226	17,624	-15,246	711	2,0127	-1,25
1990	23062	36148	156,74	1565	4,3294	-1,696	14741	40,78	23,438	3161	8,7446	-11,802	5995	16,585	-3,7102	4291	11,871	503,52
1995	23630	33286	140,86	1320	3,9656	-15,655	13596	40,846	-7,7675	2549	7,6579	-19,361	6174	18,548	2,9858	4556	13,687	6,1757
1999	23831	35337	148,28	1650	4,6693	25	14052	39,766	3,3539	2388	6,7578	-6,3162	6533	18,488	5,8147	798	2,2583	-82,485

SORON

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			2050	5,2102		500	1,2708		N.A.			1564	3,975	
1980	1569	6,2013		485	1,2109		1688	4,2143	-17,659	502	1,2533	0,4	75	0,1872		N.A.		
1985	2554	10,737	62,779	1008	2,4938	107,84	475	1,1751	-71,86	366	0,9055	-27,092	1257	3,1098	1576	1862	4,6065	
1990	2087	8,4449	-18,285	1012	2,4083	0,3968	1342	3,1936	182,53	453	1,078	23,77	897	2,1346	-28,64	1079	2,5678	-42,052
1995	2540	8,6498	21,706	570	1,2078	-43,676	1244	2,6359	-7,3025	450	0,9535	-0,6623	N.A.			1425	3,0194	32,067
1999	535	2,1807	-78,937	176	0,3602	-69,123	662	1,3547	-46,785	413	0,8452	-8,2222	1660	3,397		2668	5,4598	87,228

SAKEET

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			455	1,5242		401	1,3433		N.A.			975	3,2662	
1980	544	2,7734		1183	3,8931		374	1,2308	-17,802	291	0,9576	-27,431	117	0,385		N.A.		
1985	829	3,7455	52,39	1008	3,3026	-14,793	166	0,5439	-55,615	302	0,9895	3,7801	1116	3,6565	853,85	1166	3,8203	
1990	1178	4,9992	42,099	1140	3,2634	13,095	336	0,9618	102,41	332	0,9504	9,9338	1430	4,0936	28,136	1491	4,2682	27,873
1995	824	3,3974	-30,051	569	1,4378	-50,088	311	0,7859	-7,4405	355	0,8971	6,9277	N.A.			1967	4,9706	31,925
1999	1768	7,1564	114,56	758	1,9738	33,216	413	1,0754	32,797	475	1,2369	33,803	1820	4,7392		1896	4,9371	-3,6096

AMANPUR

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			4200	14,704		301	1,0538		N.A.			938	3,284	
1980	1723	10,275		408	1,4032		3463	11,91	-17,548	309	1,0627	2,6578	62	0,2132		N.A.		
1985	2726	16,5	58,212	613	2,0738	50,245	1291	4,3675	-62,72	272	0,9202	-11,974	1082	3,6605	1645,2	1117	3,7789	
1990	2096	12,396	-23,111	759	2,4852	23,817	2241	7,3377	73,586	226	0,74	-16,912	1032	3,3791	-4,6211	1116	3,6541	-0,0895
1995	2711	16,123	29,342	346	1,055	-54,414	2078	6,3363	-7,2735	230	0,7013	1,7699	N.A.			1472	4,4885	31,9
1999	2697	16,956	-0,5164	162	0,493	-53,179	517	1,5733	-75,12	426	1,2964	85,217	1110	3,3779		1322	4,023	-10,19

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

JAITHRA

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			1580	4,6646		1122	3,3125		N.A.			513	1,5145	
1980	486	2,0806		1124	3,2591		1380	4,0014	-12,658	821	2,3805	-26,827	72	0,2088		N.A.		
1985	446	1,9	-8,2305	1610	4,6935	43,238	908	2,647	-34,203	434	1,2652	-47,138	475	1,3847	559,72	612	1,7841	
1990	452	1,9219	1,3453	1988	5,5199	23,478	814	2,2602	-10,352	478	1,3272	10,138	434	1,2051	-8,6316	716	1,9881	16,993
1995	443	1,812	-1,9912	910	2,3495	-54,225	755	1,9493	-7,2482	472	1,2187	-1,2552		0	-100	945	2,4399	31,983
1999	672	2,8484	51,693	422	1,0537	-53,626	945	2,3597	25,166	515	1,286	9,1102	1641	4,0976		1760	4,3947	86,243

JALASER

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			1440	4,2229		322	0,9443		N.A.			2424	7,1085	
1980	937	4,0821		1134	3,2579		1179	3,3872	-18,125	235	0,6751	-27,019	343	0,9854		N.A.		
1985	1650	7,0615	76,094	1215	3,4394	7,1429	1103	3,1223	-6,4461	407	1,1521	73,191	2833	8,0196	725,95	2889	8,1781	
1990	1310	5,6803	-20,606	962	2,6613	-20,823	270	0,7469	-75,521	714	1,9752	75,43	2345	6,4872	-17,226	2357	6,5204	-18,415
1995	1644	6,9573	25,496	687	2,0639	-28,586	250	0,7511	-7,4074	720	2,1631	0,8403	N.A.			3110	9,3433	31,947
1999	1158	4,8592	-29,562	597	1,6894	-13,1	161	0,4556	-35,6	686	1,9413	-4,7222	3090	8,7444		3103	8,7812	-0,2251

SORON

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	1350	3,4311		325	0,826				
1980	1353	3,3779	0,2222	460	1,1484	41,538			
1985	1291	3,1939	-4,5824	643	1,5908	39,783			
1990	1712	4,0742	32,61	878	2,0894	36,547			
1995	1927	4,0831	12,558	832	1,7629	-5,2392			
1999	1920	3,9291	-0,3633	1201	2,4577	44,351	91	0,1862	

SAKEET

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	174	0,5829		310	1,0385				
1980	134	0,441	-22,989	434	1,4282	40			
1985	136	0,4456	1,4925	547	1,7922	26,037			
1990	123	0,3521	-9,5588	665	1,9036	21,572			
1995	138	0,3487	12,195	660	1,6678	-0,7519			
1999	87	0,2265	-36,957	727	1,8931	10,152	38	0,0778	

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999									
AMANPUR									
	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	460	1,6105		290	1,0153				
1980	457	1,5717	-0,6522	415	1,4272	43,103			
1985	547	1,8505	19,694	500	1,6915	20,482			
1990	516	1,6895	-5,6673	573	1,8762	14,6			
1995	500	1,5246	-3,1008	508	1,549	-11,344			
1999	419	1,2751	-16,2	498	1,5155	-1,9685	144	0,4382	
JAITHRA									
	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	600	1,7714		375	1,1071				
1980	477	1,3831	-20,5	534	1,5484	42,4			
1985	809	2,3584	69,602	64	0,1866	-88,015	499		
1990	497	1,38	-38,566	715	1,9853	1017,2			
1995	560	1,4459	12,676	713	1,8409	-0,2797			
1999	283	0,7067	-49,464	623	1,5556	-12,623	795		
JALASER									
	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	230	0,6745		130	0,3812				
1980	180	0,5171	-21,739	192	0,5516	47,692			
1985	86	0,2434	-52,222	358	1,0134	86,458			
1990	1071	2,9628	1145,3	388	1,0734	8,3799			
1995	120	0,3605	-88,796	380	1,1416	-2,0619			
1999	60	0,1698	-50	646	1,8281	70	6		

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

ALIGANJ

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			617	1,8281		811	2,403		N.A.			902	2,6726	
1980	183	0,7611		783	2,2789		507	1,4756	-17,828	665	1,9355	-18,002	106	0,3085		N.A.		
1985	264	1,0932	44,262	1064	2,8763	35,888	323	0,8732	-36,292	422	1,1408	-36,541	487	1,3165	359,43	1073	2,9006	
1990	222	0,8438	-15,909	1180	3,1804	10,902	197	0,531	-39,009	479	1,291	13,507	495	1,3342	1,6427	813	2,1913	-24,231
1995	262	1,008	18,018	601	1,4955	-49,068	182	0,4529	-7,6142	480	1,1944	0,2088	N.A.			1072	2,6676	31,857
1999	175	0,6741	-33,206	335	0,8037	-44,26	315	0,7557	73,077	620	1,4875	29,167	1180	2,831		1488	3,57	38,806

AWAGARH

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			1130	4,4163		311	1,2155		N.A.			1596	6,2375	
1980	1351	7,7657		1409	5,4092		930	3,5703	-17,699	226	0,8676	-27,331	288	1,1057		N.A.		
1985	2295	12,855	69,874	994	3,4041	-29,454	1801	6,1678	93,656	284	0,9726	25,664	1883	6,4486	553,82	1901	6,5103	
1990	1953	10,798	-14,902	723	2,4318	-27,264	296	0,9956	-83,565	687	2,3107	141,9	1714	5,765	-8,975	1728	5,8121	-9,1005
1995	2283	12,071	16,897	562	1,753	-22,268	274	0,8546	-7,4324	680	2,121	-1,0189	N.A.			2280	7,1117	31,944
1999	2681	13,62	17,433	499	1,5092	-11,21	129	0,3902	-52,92	625	1,8903	-8,0882	2164	6,5449		2177	6,5842	-4,5175

MAREHRA

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			2199	8,4347		455	1,7452		N.A.			726	2,7847	
1980	2881	19,608		597	2,2494		1806	6,8048	-17,872	330	1,2434	-27,473	68	0,2562		N.A.		
1985	2896	19,09	0,5207	684	2,9038	14,573	1660	7,0473	-8,0842	676	2,8699	104,85	851	3,6128	1151,5	864	3,668	
1990	2083	13,416	-28,073	1012	3,6684	47,953	1609	5,8325	-3,0723	707	2,5628	4,5858	1076	3,9004	26,439	1092	3,9584	26,389
1995	2880	17,156	38,262	386	1,3132	-61,858	1492	5,076	-7,2716	78	0,2654	-88,967	N.A.			1442	4,9059	32,051
1999	1874	11,114	-34,931	646	2,119	67,358	1758	5,7666	17,828	830	2,7226	964,1	1736	5,6944		1854	6,0815	28,571

N.KALAN

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			611	2,0192		360	1,1897		N.A.			1080	3,5691	
1980	1422	7,305		1067	3,4635		502	1,6295	-17,84	255	0,8277	-29,167	84	0,2727		N.A.		
1985	1816	8,885	27,707	1746	5,2431	63,636	194	0,5826	-61,355	444	1,3333	74,118	1276	3,8317	1419	1288	3,8678	
1990	1299	6,0393	-28,469	908	2,7791	-47,995	230	0,704	18,557	550	1,6834	23,874	1203	3,6821	-5,721	1208	3,6974	-6,2112
1995	1806	8,3681	39,03	987	2,645	8,7004	213	0,5708	-7,3913	550	1,4739	0	N.A.			1593	4,2691	31,871
1999	1324	6,1155	-26,689	721	1,9834	-26,95	346	0,9518	62,441	530	1,458	-3,6364	2329	6,4068		2488	6,8442	56,183

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975—1999

KASGANJ

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			5007	14,212		402	1,1411		N.A.			1584	4,4962	
1980	3286	17,442		428	1,1934		4167	11,619	-16,777	432	1,2046	7,4627	158	0,4406		N.A.		
1985	3611	19,411	9,8904	479	1,2942	11,916	282	0,7619	-93,233	602	1,6265	39,352	1862	5,0308	1078,5	1887	5,0983	
1990	3270	17,461	-9,4434	739	1,9897	54,28	3310	8,912	1073,8	688	1,8524	14,286	1608	4,3294	-13,641	1675	4,5098	-11,235
1995	3593	18,834	9,8777	270	0,7156	-63,464	3071	8,1394	-7,2205	680	1,8023	-1,1628	N.A.			2210	5,8574	31,94
1999	1755	9,6091	-51,155	263	0,7837	-2,5926	1242	3,7008	-59,557	766	2,2825	12,647	1759	5,2414		2093	6,2366	-5,2941

ALIGANJ

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	25201	33750	133,92	1040	3,0815		11512	34,11		387	1,1467		6348	18,809		5780	17,126	
1980	24043	34358	142,9	1336	3,8885	28,462	11959	34,807	3,8829	466	1,3563	20,413	6680	19,442	5,23	5071	14,759	-12,266
1985	24149	36992	153,18	1723	4,6578	28,967	12379	33,464	3,512	680	1,8382	45,923	6040	16,328	-9,5808	5787	15,644	14,12
1990	26309	37102	141,02	1229	3,3125	-28,671	13339	35,952	7,7551	528	1,4231	-22,353	5363	14,455	-11,209	5931	15,986	2,4883
1995	25992	40186	154,61	1264	3,1454	2,8478	13854	34,475	3,8609	425	1,0576	-19,508	5223	12,997	-2,6105	6297	15,67	6,171
1999	25959	41681	160,56	1348	3,2341	6,6456	14319	34,354	3,3564	404	0,9693	-4,9412	5945	14,263	13,823	6652	15,959	5,6376

AWAGARH

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	18235	25587	140,32	3185	12,448		8413	32,88		1514	5,9171		3153	12,323		1460	5,706	
1980	17397	26048	149,73	4090	15,702	28,414	8742	33,561	3,9106	1822	6,9948	20,343	3317	12,734	5,2014	1474	5,6588	0,9589
1985	17853	29200	163,56	4239	14,517	3,643	10966	37,555	25,44	2248	7,6986	23,381	3265	11,182	-1,5677	1325	4,5377	-10,109
1990	18087	29731	164,38	3916	13,171	-7,6197	11508	38,707	4,9425	2228	7,4939	-0,8897	2389	8,0354	-26,83	1384	4,6551	4,4528
1995	18913	32060	169,51	4165	12,991	6,3585	12340	38,49	7,2298	1796	5,602	-19,39	2460	7,6731	2,972	1470	4,5852	6,2139
1999	19685	33064	167,97	5145	15,561	23,529	12754	38,574	3,3549	1264	3,8229	-29,621	3399	10,28	38,171	1126	3,4055	-23,401

MREHRA

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	15100	26071	172,66	815	3,1261		7921	30,382		923	3,5403		5083	19,497		2930	11,239	
1980	14693	26540	180,63	1047	3,945	28,466	8231	31,014	3,9136	1108	4,1748	20,043	5549	20,908	9,1678	2914	10,98	-0,5461
1985	15170	23555	155,27	1245	5,2855	18,911	9172	38,939	11,432	1162	4,9331	4,8736	5005	21,248	-9,8036	2643	11,221	-9,2999
1990	15526	27587	177,68	1098	3,9801	-11,807	10036	36,379	9,42	1473	5,3395	26,764	4346	15,754	-13,167	3367	12,205	27,393
1995	16787	29393	175,09	1130	3,8445	2,9144	8887	30,235	-11,449	1188	4,0418	-19,348	4476	15,228	2,9913	3576	12,166	6,2073
1999	16861	30486	180,81	1279	4,1954	13,186	9185	30,129	3,3532	1113	3,6509	-6,3131	4630	15,187	3,4406	4059	13,314	13,507

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

N.KALAN

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	20403	30260	148,31	2910	9,6167		11842	39,134		1924	6,3582		3170	10,476		3680	12,161	
1980	19466	30807	158,26	3737	12,13	28,419	12306	39,945	3,9183	2311	7,5015	20,114	3334	10,822	5,1735	3661	11,884	-0,5163
1985	20439	33301	162,93	3213	9,6484	-14,022	13788	41,404	12,043	2966	8,9066	28,343	3415	10,255	2,4295	3429	10,297	-6,3371
1990	21509	32672	151,9	430	1,3161	-86,617	13586	41,583	-1,465	2103	6,4367	-29,096	3182	9,7392	-6,8228	3299	10,097	-3,7912
1995	21582	37315	172,9	400	1,072	-6,9767	14515	38,899	6,8379	1696	4,5451	-19,353	3277	8,782	2,9855	3503	9,3876	6,1837
1999	21650	36352	167,91	3232	8,8908	708	15002	41,269	3,3551	2100	5,7768	23,821	3993	10,984	21,849	3244	8,9239	-7,3937

KASGANJ

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	18930	35230	186,11	580	1,6463		8475	24,056		1200	3,4062		9156	25,989		3670	10,417	
1980	18840	35864	190,36	746	2,0801	28,621	8804	24,548	3,882	1448	4,0375	20,667	9638	26,874	5,2643	3678	10,255	0,218
1985	18603	37012	198,96	523	1,4131	-29,893	12061	32,587	36,995	1301	3,5151	-10,152	8006	21,631	-16,933	4211	11,377	14,492
1990	18727	37141	198,33	262	0,7054	-49,904	9443	25,425	-21,706	1350	3,6348	3,7663	6804	18,319	-15,014	4819	12,975	14,438
1995	19077	37730	197,78	360	0,9541	37,405	11281	29,899	19,464	1088	2,8836	-19,407	7008	18,574	2,9982	5117	13,562	6,1839
1999	18264	33560	183,75	337	1,0042	-6,3889	11660	34,744	3,3596	1134	3,379	4,2279	6805	20,277	-2,8967	5696	16,973	11,315

ALIGANJ

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			617	1,8281		811	2,403		N.A.			902	2,6726	
1980	183	0,7611		783	2,2789		507	1,4756	-17,828	665	1,9355	-18,002	106	0,3085		N.A.		
1985	264	1,0932	44,262	1064	2,8763	35,888	323	0,8732	-36,292	422	1,1408	-36,541	487	1,3165	359,43	1073	2,9006	
1990	222	0,8438	-15,909	1180	3,1804	10,902	197	0,531	-39,009	479	1,291	13,507	495	1,3342	1,6427	813	2,1913	-24,231
1995	262	1,008	18,018	601	1,4955	-49,068	182	0,4529	-7,6142	480	1,1944	0,2088	N.A.			1072	2,6676	31,857
1999	175	0,6741	-33,206	335	0,8037	-44,26	315	0,7557	73,077	620	1,4875	29,167	1180	2,831		1488	3,57	38,806

AWAGARH

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			1130	4,4163		311	1,2155		N.A.			1596	6,2375	
1980	1351	7,7657		1409	5,4092		930	3,5703	-17,699	226	0,8676	-27,331	288	1,1057		N.A.		
1985	2295	12,855	69,874	994	3,4041	-29,454	1801	6,1678	93,656	284	0,9726	25,664	1883	6,4486	553,82	1901	6,5103	
1990	1953	10,798	-14,902	723	2,4318	-27,264	296	0,9956	-83,565	687	2,3107	141,9	1714	5,765	-8,975	1728	5,8121	-9,1005
1995	2283	12,071	16,897	562	1,753	-22,268	274	0,8546	-7,4324	680	2,121	-1,0189	N.A.			2280	7,1117	31,944
1999	2681	13,62	17,433	499	1,5092	-11,21	129	0,3902	-52,92	625	1,8903	-8,0882	2164	6,5449		2177	6,5842	-4,5175

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

MAREHRA

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			2199	8,4347		455	1,7452		N.A.			726	2,7847	
1980	2881	19,608		597	2,2494		1806	6,8048	-17,872	330	1,2434	-27,473	68	0,2562		N.A.		
1985	2896	19,09	0,5207	684	2,9038	14,573	1660	7,0473	-8,0842	676	2,8699	104,85	851	3,6128	1151,5	864	3,668	
1990	2083	13,416	-28,073	1012	3,6684	47,953	1609	5,8325	-3,0723	707	2,5628	4,5858	1076	3,9004	26,439	1092	3,9584	26,389
1995	2880	17,156	38,262	386	1,3132	-61,858	1492	5,076	-7,2716	78	0,2654	-88,967	N.A.			1442	4,9059	32,051
1999	1874	11,114	-34,931	646	2,119	67,358	1758	5,7666	17,828	830	2,7226	964,1	1736	5,6944		1854	6,0815	28,571

N.KALAN

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			611	2,0192		360	1,1897		N.A.			1080	3,5691	
1980	1422	7,305		1067	3,4635		502	1,6295	-17,84	255	0,8277	-29,167	84	0,2727		N.A.		
1985	1816	8,885	27,707	1746	5,2431	63,636	194	0,5826	-61,355	444	1,3333	74,118	1276	3,8317	1419	1288	3,8678	
1990	1299	6,0393	-28,469	908	2,7791	-47,995	230	0,704	18,557	550	1,6834	23,874	1203	3,6821	-5,721	1208	3,6974	-6,2112
1995	1806	8,3681	39,03	987	2,645	8,7004	213	0,5708	-7,3913	550	1,4739	0	N.A.			1593	4,2691	31,871
1999	1324	6,1155	-26,689	721	1,9834	-26,95	346	0,9518	62,441	530	1,458	-3,6364	2329	6,4068		2488	6,8442	56,183

KASGANJ

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			5007	14,212		402	1,1411		N.A.			1584	4,4962	
1980	3286	17,442		428	1,1934		4167	11,619	-16,777	432	1,2046	7,4627	158	0,4406		N.A.		
1985	3611	19,411	9,8904	479	1,2942	11,916	282	0,7619	-93,233	602	1,6265	39,352	1862	5,0308	1078,5	1887	5,0983	
1990	3270	17,461	-9,4434	739	1,9897	54,28	3310	8,912	1073,8	688	1,8524	14,286	1608	4,3294	-13,641	1675	4,5098	-11,235
1995	3593	18,834	9,8777	270	0,7156	-63,464	3071	8,1394	-7,2205	680	1,8023	-1,1628	N.A.			2210	5,8574	31,94
1999	1755	9,6091	-51,155	263	0,7837	-2,5926	1242	3,7008	-59,557	766	2,2825	12,647	1759	5,2414		2093	6,2366	-5,2941

ALIGANJ

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	340	1,0074		754	2,2341				
1980	278	0,8091	-18,235	1081	3,1463	43,369	1627	4,7354	
1985	387	1,0462	39,209	129	0,3487	-88,067	3417	9,2371	
1990	483	1,3018	24,806	1528	4,1184	1084,5	2699	7,2745	
1995	543	1,3512	12,422	1500	3,7326	-1,8325	2699	6,7163	
1999	267	0,6406	-50,829	1249	2,9966	-16,733	4908	11,775	

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975—1999

AWAGARH

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	240	0,938		150	0,5862				
1980	199	0,764	-17,083	203	0,7793	35,333			
1985	206	0,7055	3,5176	228	0,7808	12,315			
1990	278	0,9351	34,951	237	0,7971	3,9474			
1995	313	0,9763	12,59	240	0,7486	1,2658			
1999	47	0,1421	-84,984	488	1,4759	103,33			

MREHRA

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	227	0,8707		140	0,537				
1980	175	0,6594	-22,907	348	1,3112	148,57			
1985	212	0,9	21,143	326	1,384	-6,3218			
1990	176	0,638	-16,981	440	1,595	34,969			
1995	199	0,677	13,068	430	1,4629	-2,2727			
1999	42	0,1378	-78,894	441	1,4466	2,5581			

N.KALAN

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	158	0,5221		210	0,694				
1980	118	0,383	-25,316	306	0,9933	45,714			
1985	97	0,2913	-17,797	381	1,1441	24,51			
1990	104	0,3183	7,2165	345	1,056	-9,4488			
1995	117	0,3135	12,5	300	0,804	-13,043			
1999	42	0,1155	-64,103	416	1,1444	38,667			

KASGANJ

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	270	0,7664		310	0,8799				
1980	277	0,7724	2,5926	453	1,2631	46,129			
1985	147	0,3972	-46,931	483	1,305	6,6225			
1990	100	0,2692	-31,973	524	1,4108	8,4886			
1995	115	0,3048	15	523	1,3862	-0,1908			
1999	126	0,3754	9,5652	406	1,2098	-22,371	12		

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

SAHAWAR

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	16086	23423	145,61	866	3,6972		6327	27,012		330	1,4089		5426	23,165		2470	10,545	
1980	16089	23343	145,09	1087	4,6566	25,52	6575	28,167	3,9197	351	1,5037	6,3636	5710	24,461	5,2341	2462	10,547	-0,3239
1985	15169	25011	164,88	1158	4,63	6,5317	7138	28,539	8,5627	722	2,8867	105,7	5825	23,29	2,014	2775	11,095	12,713
1990	15782	27135	171,94	1346	4,9604	16,235	7735	28,506	8,3637	783	2,8856	8,4488	2520	9,2869	-56,738	3713	13,683	33,802
1995	15014	28092	187,11	1942	6,913	44,279	9193	32,725	18,849	631	2,2462	-19,413	2595	9,2375	2,9762	3942	14,032	6,1675
1999	13225	28922	218,69	2282	7,8902	17,508	9501	32,85	3,3504	538	1,8602	-14,739	3843	13,287	48,092	3548	12,267	-9,9949

G.DUNDWARA

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	21828	25390	116,32	1246	4,9074		9140	35,998		861	3,3911		4375	17,231		2160	8,5073	
1980	20825	25847	124,12	1599	6,1864	28,331	9500	36,755	3,9387	1059	4,0972	22,997	4607	17,824	5,3029	5155	19,944	138,66
1985	18902	26007	137,59	1003	3,8567	-37,273	9386	36,09	-1,2	930	3,576	-12,181	4401	16,922	-4,4715	3085	11,862	-40,155
1990	17806	25863	145,25	1049	4,056	4,5862	9520	36,809	1,4277	807	3,1203	-13,226	3490	13,494	-20,7	2908	11,244	-5,7374
1995	23135	31282	135,22	1890	6,0418	80,172	11447	36,593	20,242	650	2,0779	-19,455	3594	11,489	2,9799	3087	9,8683	6,1554
1999	22287	31056	139,35	1870	6,0214	-1,0582	11831	38,096	3,3546	697	2,2443	7,2308	4448	14,323	23,762	3670	11,817	18,886

PATIALI

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	19876	24248	122	1400	5,7737		7942	32,753		400	1,6496		4738	19,5398		2130	8,7842	
1980	18963	24685	130,17	1798	7,2838	28,429	8251	33,425	3,8907	460	1,8635	15	4986	20,199	5,2343	2118	8,5801	-0,5634
1985	18673	28937	154,97	1951	6,7422	8,5095	10161	35,114	23,149	701	2,4225	52,391	4663	16,114	-6,4781	2888	9,9803	36,355
1990	18705	26758	143,05	1307	4,8845	-33,009	9324	34,846	-8,2374	985	3,6811	40,514	3404	12,721	-27	3220	12,034	11,496
1995	20010	28895	144,4	2100	7,2677	60,673	11345	39,263	21,675	794	2,7479	-19,391	3506	12,134	2,9965	3419	11,832	6,1801
1999	20635	32562	157,8	2189	6,7226	4,2381	11724	36,005	3,3407	388	1,1916	-51,134	4686	14,391	33,657	3240	9,9502	-5,2354

SIRPURA

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	15630	23269	148,87	2081	8,9432		7790	33,478		485	2,0843		4890	21,015		2490	10,701	
1980	15563	23688	152,21	2673	11,284	28,448	8100	34,195	3,9795	581	2,4527	19,794	5146	21,724	5,2352	2507	10,583	0,6827
1985	15698	26176	166,75	2059	7,866	-22,97	8750	33,428	8,0247	553	2,1126	-4,8193	4513	17,241	-12,301	2729	10,426	8,8552
1990	15058	25726	170,85	1229	4,7773	-40,311	8373	32,547	-4,3086	838	3,2574	51,537	3350	13,022	-25,77	4000	15,548	46,574
1995	16176	27129	167,71	3504	12,916	185,11	9367	34,528	11,871	677	2,4955	-19,212	3450	12,717	2,9851	4247	15,655	6,175
1999	15866	28465	179,41	3534	12,415	0,8562	9681	34,01	3,3522	562	1,9744	-16,987	3239	11,379	-6,1159	3333	11,709	-21,521

APPEINDIX A

BLOCK WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975—1999

SHEETALPUR

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	21630	33897	156,71	1077	3,1773		12035	35,505		1246	3,6758		6595	19,456		2089	6,1628	
1980	20634	34504	167,22	1383	4,0082	28,412	12508	36,251	3,9302	1501	4,3502	20,465	6937	20,105	5,1857	2885	8,3613	38,104
1985	20619	37678	182,73	1660	4,4058	20,029	13876	36,828	10,937	1728	4,5862	15,123	5923	15,72	-14,617	4063	10,783	40,832
1990	21346	35591	166,73	2310	6,4904	39,157	11674	32,8	-15,869	1796	5,0462	3,9352	4533	12,736	-23,468	4545	12,77	11,863
1995	22759	39754	174,67	3478	8,7488	50,563	14329	36,044	22,743	1448	3,6424	-19,376	4668	11,742	2,9782	4826	12,14	6,1826
1999	23714	42388	178,75	3707	8,7454	6,5842	14810	34,939	3,3568	1731	4,0837	19,544	4130	9,7433	-11,525	4773	11,26	-1,0982

SAHAWAR

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			1975	8,4319		320	1,3662		N.A.			890	3,7997	
1980	808	5,0221		339	1,4523		1622	6,9485	-17,873	319	1,3666	-0,3125	47	0,2013		N.A.		
1985	1209	7,9702	49,629	672	2,6868	98,23	3514	14,05	116,65	146	0,5837	-54,232	698	2,7908	1385,1	1062	4,2461	
1990	900	5,7027	-25,558	714	2,6313	6,25	1501	5,5316	-57,285	236	0,8697	61,644	848	3,1251	21,49	953	3,5121	-10,264
1995	1203	8,0125	33,667	380	1,3527	-46,779	1392	4,9551	-7,2618	240	0,8543	1,6949	N.A.			1258	4,4781	32,004
1999	1869	14,132	55,362	115	0,3976	-69,737	338	1,1687	-75,718	237	0,8194	-1,25	1204	4,1629		1320	4,564	4,9285

G.DUNDWARA

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			330	1,2997		335	1,3194		N.A.			1189	4,6829	
1980	158	0,7587		680	2,6309		270	1,0446	-18,182	347	1,3425	3,5821	106	0,4101		N.A.		0
1985	212	1,1216	34,177	957	3,6798	40,735	149	0,5729	-44,815	149	0,5729	-57,061	879	3,3799	729,25	1417	5,4485	
1990	153	0,8593	-27,83	1325	5,1231	38,454	470	1,8173	215,44	210	0,812	40,94	667	2,579	-24,118	1038	4,0135	-26,747
1995	210	0,9077	37,255	541	1,7294	-59,17	436	1,3938	-7,234	200	0,6393	-4,7619	N.A.			1369	4,3763	31,888
1999	142	0,6371	-32,381	300	0,966	-44,547	321	1,0336	-26,376	65	0,2093	-67,5	1841	5,928		2031	6,5398	48,356

PATIALI

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.	#####		N.A.			837	3,4518		780	3,2168		N.A.			691	2,8497	
1980	420	2,2148		639	2,5886		688	2,7871	-17,802	789	3,1963	1,1538	119	0,4821		N.A.		0
1985	1489	7,9741	254,52	1440	4,9763	125,35	570	1,9698	-17,151	257	0,8881	-67,427	512	1,7694	330,25	823	2,8441	
1990	200	1,0692	-86,568	1171	4,3763	-18,681	412	1,5397	-27,719	252	0,9418	-1,9455	990	3,6998	93,359	1680	6,2785	104,13
1995	1481	7,4013	640,5	814	2,8171	-30,487	382	1,322	-7,2816	280	0,969	11,111	N.A.			2217	7,6726	31,964
1999	574	2,7817	-61,242	354	1,0872	-56,511	245	0,7524	-35,864	45	0,1382	-83,929	1693	5,1993		1916	5,8842	-13,577

APPEINDIX A

BLOCK WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

SIRPURA

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			2590	11,131		430	1,848			0		606	2,6043	
1980	1340	8,6102		635	2,6807		2126	8,975	-17,915	314	1,3256	-26,977	73	0,3082		N.A.		
1985	402	2,5608	-70	644	2,4603	1,4173	201	0,7679	-90,546	192	0,7335	-38,854	696	2,6589	853,42	723	2,7621	
1990	571	3,792	42,04	893	3,4712	38,665	844	3,2807	319,9	272	1,0573	41,667	991	3,8521	42,385	1064	4,1359	47,165
1995	399	2,4666	-30,123	364	1,3417	-59,239	782	2,8825	-7,346	270	0,9952	-0,7353	N.A.			1403	5,1716	31,861
1999	2187	13,784	448,12	198	0,6956	-45,604	517	1,8163	-33,887	187	0,6569	-30,741	925	3,2496		1024	3,5974	-27,014

SHEETALPUR

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A.			2320	6,8443		890	2,6256		N.A.			1195	3,5254	
1980	2171	10,521		1017	2,9475		1910	5,5356	-17,672	637	1,8462	-28,427	40	0,1159		N.A.		
1985	2360	11,446	8,7057	1229	3,2619	20,846	1112	2,9513	-41,78	663	1,7596	4,0816	1370	3,6361	3325	1422	3,7741	
1990	3089	14,471	30,89	1086	3,0513	-11,635	653	1,8347	-41,277	880	2,4725	32,73	1063	2,9867	-22,409	1139	3,2002	-19,902
1995	2347	10,312	-24,021	695	1,7483	-36,004	605	1,5219	-7,3507	875	2,201	-0,5682	N.A.		0	1503	3,7808	31,958
1999	3168	13,359	34,981	939	2,2152	35,108	1521	3,5883	151,4	874	2,0619	-0,1143	1827	4,3102		1980	4,6711	31,737

SAHAWAR

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	1710	7,3005		159	0,6788				
1980	1740	7,4541	1,7544	229	0,981	44,025			
1985	1515	6,0573	-12,931	353	1,4114	54,148			
1990	1807	6,6593	19,274	400	1,4741	13,314			
1995	2034	7,2405	12,562	430	1,5307	7,5			
1999	2116	7,3162	4,0315	363	1,2551	-15,581	363		

G.DUNDWARA

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	590	2,3237		255	1,0043				
1980	558	2,1589	-5,4237	366	1,416	43,529			
1985	424	1,6303	-24,014	454	1,7457	24,044			
1990	972	3,7583	129,25	567	2,1923	24,89			
1995	1094	3,4972	12,551	561	1,7934	-1,0582			
1999	1249	4,0218	14,168	461	1,4844	-17,825	729		

APPEINDIX A

BLOCK-WISE CHANGING CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999									
PATIALI									
	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	401	1,6537		175	0,7217			0	
1980	357	1,4462	-10,973	25	0,1013	-85,714		0	
1985	639	2,2082	78,992	496	1,7141	1884	818	2,8268	
1990	1028	3,8418	60,876	429	1,6033	-13,508		0	
1995	1157	4,0042	12,549	400	1,3843	-6,7599		0	
1999	1473	4,5237	27,312	451	1,3851	12,75	1147	3,5225	
SIRPURA									
	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	580	2,4926		230	0,9884			0	
1980	447	1,887	-22,931	338	1,4269	46,957		0	
1985	652	2,4908	45,861	486	1,8567	43,787		0	
1990	795	3,0903	21,933	579	2,2506	19,136	2861	11,121	
1995	895	3,2991	12,579	570	2,1011	-1,5544		0	
1999	494	1,7355	-44,804	426	1,4966	-25,263	793	2,7859	
SHEETALPUR									
	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	143	0,4219		435	1,2833			0	
1980	110	0,3188	-23,077	627	1,8172	44,138		0	
1985	158	0,4193	43,636	733	1,9454	16,906		0	
1990	177	0,4973	12,025	595	1,6718	-18,827		0	
1995	200	0,5031	12,994	504	1,2678	-15,294		0	
1999	125	0,2949	-37,5	774	1,826	53,571	74	0,1746	

APPEINDIX A

CROPPING PATTERN IN DISTRICT ETAH DURING 1975---1999

				RICE			WHEAT			BARLEY			MILLETS			MAIZE		
YEAR	N.S.A.	G.S.A.	a	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	302495	446857	147,72	23457	5,2493		134187	30,029		15245	3,4116		87498	19,581		56971	12,749	
1980	294511	454498	154,32	30110	6,6249	28,363	150662	33,149	12,278	18324	4,0317	20,197	92274	20,302	5,4584	48255	10,617	-15,299
1985	294557	473999	160,92	28293	5,969	-6,0345	165853	34,99	10,083	21525	4,5411	17,469	82115	17,324	-11,01	48319	10,194	0,1326
1990	300622	484964	161,32	24492	5,0503	-13,434	172026	35,472	3,722	21406	4,4139	-0,5528	67862	13,993	-17,357	58871	12,139	21,838
1995	317956	523416	164,62	33279	6,358	35,877	188477	36,009	9,5631	16984	3,2448	-20,658	141590	27,051	108,64	62507	11,942	6,1762
1999	310713	534051	171,88	38760	7,2577	16,47	194802	36,476	3,3558	16554	3,0997	-2,5318	76051	14,24	-46,288	60630	11,353	-3,0029

	GREEN GRAM			GRAM			PEAS			ARHER			MUSTERED			OIL SEED		
YEAR	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1975	N.A.			N.A			27341	6,1185		7740	1,7321		N.A			16873	3,7759	
1980	19279	6,5461		11928	2,6244		22612	4,9752	-17,296	6472	1,424	-16,382	1758	0,3868		N.A		
1985	24759	8,4055	28,425	15363	3,2411	28,798	13749	2,9006	-39,196	5616	1,1848	-13,226	17277	3,6449	882,76	20106	4,2418	
1990	20863	6,9399	-15,736	15612	3,2192	1,6208	14525	2,9951	5,644	7164	1,4772	27,564	16793	3,4627	-2,8014	19149	3,9485	-4,7598
1995	24626	7,7451	18,037	8682	1,6587	-44,389	13467	2,5729	-7,284	6560	1,2533	-8,431	N.A			25266	4,8271	31,944
1999	22579	7,2668	-8,3124	6485	1,2143	-25,305	9430	1,7657	-29,977	7294	1,3658	11,189	25979	4,8645		29120	5,4527	15,254

	SUGAR CANE			POTATO			TOBACCO		
YEAR	A	B	C	A	B	C	A	B	
1975	7473	1,6723		4248	0,9506		N.A		
1980	6860	1,5094	-8,2029	6011	1,3226	41,502	2468	0,543	
1985	7306	1,5414	6,5015	6181	1,304	2,8281	6206	1,3093	
1990	9839	2,0288	34,67	8863	1,8276	43,391	5661	1,1673	
1995	9912	1,8937	0,7419	8551	1,6337	-3,5203	4429	0,8462	
1999	8750	1,6384	-11,723	9170	1,7171	7,2389	9100	1,704	

Source- District Statistical Bulletins; 1975,1980,1985,1990,1995 and 1999

a- Intensity of cropping.

A- Total area of the particular crop in hectare.

B-Percentage crop acreage of net sown area.

C- Percentage increase or decrease in crop acreage.

Bibliography

BOOKS

1. Bandyopadhyay, J. and Shiva, V., (1992) 'Green Revolution and Increased Vulnerability to Drought and Desertification in Arid Regions' in Bahuguna, S.; Shiva, V. and Buchi, M.M. (Eds.) *Environmental Crises and Sustainable Devlopment,* Natraj Publication, Dehradun.

2. Basu, D., (1995), *Environment and Ecology, The Global Challenges (ed.),* Jaipur, Print Well.

3. Berkes, F., et. al., (1998) 'Mountain Ecosystem and Sustainability: Conclusion and Policy Implications', R.B. Singh (Eds.) *Sustainable Development of Mountain Environment in India and Canada,* Oxford and IBH Publishing Co., New Delhi.

4. Bsue, D.N., (1996), *Agro-climatic Regional Planning in India (ed.),* New Delhi, Concept Publishing Co.

5. Castro,G., (1992) , 'Global Development and Environmental Crisis: Overview on Latin America' in Bahuguna, S. Shiva, V. and Buchi, M.M. (Eds), *Environmental Crises and Sustainable Development,* Natraj Publication, Dehradun.

6. Chauhan, I.S., (1998), *Environmental Degradation: Socio Economic Consequences,* Rawat Publications.

7. Dube,R.S. and Misra, R.P., (1981): Levels of Education: 'A Versatile Indicator of Regional Development', *Geographical Review of India,*Vol. 43, Calcutta.

8. Dubey, S.K. and Deep N. Pandey, (1993), The effect of Afforestation on the abundance and diversity of birds.

Afforestation of Arid Lands (Ed.), A. P. Dwivedi and C. N. Gupta. Jodhpur: Scientific Publishers, Pp. 313-320.

9. Dutt, L.N., (1997), *Agricultural Production & Farm Size,* Ranchi University Publishing Co.

10. Gosal, G.S. and Ojha, B.S., (1967), *Agricultural Land Use in Punjab: A Spatial Analysis,* New Delhi, IIPA.

11. Hussain Majid (1992), *Agricultural Geography,* Delhi, Inter-India Publication.

12. Jaeswal, K.S., (1997), *Agricultural Technology and Fertilizers Development,* Allahabad, Chung Publications.

13. Jain, R.K., et.al., (1977), *Environmental Impact Analysis,* New York, Van Nostr and Reinhold.

14. Mecher, J.P., (1978), *Agriculture and Social Structure in Tamil Nadu,* Allied Publication.

15. Meena R.C.L. and Deep N. Pandey, (1999), *Van Kaa Viraat Roop: Use, Abuse and Proper Use of Forests* (in Hindi). Udaipur and New Delhi: Himanshu Publishers.

16. Meyer, Willium, B., (1994), *Changes in Land Use and Land Cover: A Global Perspective,* Cambridge, Cambridge University press.

17. Mohmmad Noor (1992), *Spatial Dimension in Agriculture (ed.),* Vol. 2,3,4,5,6 and 7, New Delhi, Concept Publishing Company.

18. Pandey, Deep N., (1989), Management of Ethno-botanical Resources and Socio-economic Development of the Tribes of M.P., *Environment,* Dehradun: I.G.N.F.A. 8-11.

19. Pandey, Deep N., (1991), Diversity and Management of Indian Tree Cavity Nesting Birds Wildlife, *Institute of Indian News Letter* 6 (3-4): 30-32.

20. Pandeya, P.C., (nd.), *Agricultural Planning in a Backward Economy*, Allahbad, Chung Publication.

21. Phillips, A.D.M. and Turton, B.J., (1975), *Environment, Man and Economic Changes (ed.)*, London, Longman.

22. Raina, J.L., (1989), *Locational Analysis in Agricultural Geography*, Jaipur, Pointer Publishers.

23. Ramakrishanan, P.S. and O.P. Toky, (1978), Preliminary Observations on the Impact of Jhum (shifting agriculture) on the Forested Ecosystem. *Resources, Development and Environment in the Himalayan Region*, Dept., Sci. & Technol., Govt. of India, New Delhi, Pp.343-354.

24. Ramakrishanan, P.S. and U. Gupta, (1980), The Effect of Time of Year on Competitive Ability of the Closely Related Species of *Argemone. Trop. Ecol.*, 21: 164- 173.

25. Ramakrishanan, P.S., (1978), Approaches to Studies on Forest Ecosystem Function in the North-eastern Hill Region, *Environmental Physiology and Ecology of Plants* (Ed.) D.N. Sen and R.P. Bansal, Dehra Dun: Bishen Singh and Mahendra Pal Singh. Pp.97- 108.

26. Ramakrishanan, P.S., (1978), Observations on Biological Aspects of Productivity of Forest Ecosystems, *Glimpses of Ecology* (Ed.) J.S. Singh and B. Gopal, Jaipur: Internat. Sci. Publ, India, Pp. 196-199.

27. Ruttan, V.W., (1994), 'Agricultural Environment and Health' (Eds.): *Towards Sustainable Development in 21st Century*, Minnepolis.

28. Sahu, B.N., (1979), *Crop Substitution in Orissa,* New Delhi, ICAR.

29. Shafi, M. ( ), *Agricultural Productivity and Regional Imblances, A Study of Uttar Pradesh,* New Delhi, Concept Publishing Co.

30. Shafi, M.and Raza, M., (1994),Ed., *Geography of Environment,* Rawat Pub., Jaipur.

31. Takahashi, K. and Yoshinon, M.M., (1978), *Climatic Change and Food Production (ed.),* University of Tokyo Press.

32. Tewari,P.T.,(1984),*Changing pattern of Development in India,* Delhi.

33. Torrant, J.R., (1974), *Agricultural Geography,* David and Charls: Newton Abbot.

34. Wang, J.Y., (1984), *Agriculture and Its Environment, Prediction and Controls,* Dubuque, Kendall Hand.

35. Yadave, N.D.; Gupta, I.C. and Pal, S., (1994), *Cropping System Research in India (1980-91),* Delhi, Indian Publishers.

JOURNALS

2. Ahluwalia, D., (1989) 'Source of Recent Growth in Rice and Wheat Output' *Economic and Political Weekly*, Sep. 30, Vol. XXIV, No.39, pp. A137-A144.
3. Asima Nusrat and Mahdev, P.D., (Dec.1991) 'Environmental Impact of Brick-Loam Quarrying on Agricultural soil', *The Indian Geographical Journal*, Vol. 66, No. 2, pp. 83-88.
4. Baillie, I.C., et., al., (2001) 'Soils and Land Use on the Litho-logically Diverse Ophiolitic Alluvial Coastal Plain of Palawan, Philippines' *Singapur Journal of Tropical Geography*, Vol. 22, No. 1, pp. 1-14.
5. Bezbaruah, M.P., (1998) 'Regional and Seasonal Variation in the Trend of Rice Production in Assam' *Indian Journal of Regional Sciences*, Vol. XXX, No. 2, pp. 70-83.
6. Chakraborty, P.K., Huda, A.K.S., et.al. (1980) 'Rainfall and Its Impact on Cropping Pattern in Hooghly District W.B.", *Indian Journal of Agricultural Science*, Vol. 60, pp. 101-106.
7. Charan, K.C. and Marafa, M., (June. 1999) 'Vegetation Chronosequence in Hong Kong: Soil Properties and Successional Development' *Singapur Journal of Tropical Geography*, vol. 20, No. 1, pp. 24-35.
8. Chhonkar, P.K. and Rttan, R.K., (Feb. 2000) 'Soil Fertility Management for Sustainable Agriculture' *Indian Farming*, Vol. 49, No. 11, pp. 26-31.
9. Dan, S. and Ian Wilcox, (Apr. 1996) 'Assessing a Regulating Approach to Controlling Agricultural Polution: The Experience of Ellice Township, Ontario, Canada' *Applied Geography*, Vol. 16, No. 2, pp. 123-136.

10. Deena, D., (1998) 'Inter-State Variation in Cropping in India' *Indian Journal of Regional Sciences,* Vol. XXX, No. 2, pp. 57-69.

11. Deosthali, V., (1997) 'Cropping Pattern for Ahmednagar & Solapur District Mahrashtra' *The Indian Geographical Journal,* Vol. 72, No. 1, pp. 20-26.

12. Gaona, S.O. and Espinasa, M.G., (2000) 'Land Use and Deforestation in the High Land of Chiajoas, Maxico' *Applied Geography,* Vol. 20, No. 1, pp 17-42.

13. Gulati, S.C., (1977) 'Dimention of Inter District Disparities, *Indian Journal of Regional Science,* Vol. 9, No. 2.

14. Hartshone, R. and Dicken, Samuel, N. (1935) 'A Classification of Agricultural Regions of Europe and North America on a Uniform Statistical Basis' *Annals of the Association of American Geographer,* Vol. 25, p101.

15. Hill, R.D., (Jun.1998) 'Stasis and Change in Forty years of South Asian Agriculture", *Singapur Journal of Tropical Geography,* Vol. 19, No. 1, pp.1-25.

16. Israili, A.W. and Muinuddin, (1991) 'Impacts of Trace Eliments of Plants in Western Uttar Pradesh' *The Geographer,* Vol. XXXVIII, No. 2.

17. Jain, R.K., (2002) 'Influence of Tree Growth on Reclamation of Sodic Soil' *The Indian Journal of Agricultural Science,* Vol. 72, No. 1, pp.39-41.

18. Johnson, Peter, C., (1994) 'Ecology and change in the agricultural system of the Kaonde of North Western Zambia", *Singapur Journal of Topographical Geography,*Vol.15, No. 1, pp.1-16.

19. Kumar, P.M., (1989) 'Crop Economics and Cropping Pattern Changes' *Economic and Political Weekly,* Vol. XXIV, No. 51&52, Dec. 23-30, pp. A159-A168.

20. Kumar, Vinod, et. al., (Feb. 2000) 'Complementary Effect of Crop Wastes and Inorganic Fertilizers on Yield, Nutrient Uptake and Residual Fertility in Mustered-Rice Cropping Sequence' *The Indian Journal of Agricultural Sciences,* Vol. 70, No. 1, pp. 69-72.

21. Lal, S., (Jan. 1998) 'Introduction of Pulses in Rice Wheat Cropping System' *Indian Farming,* Vol. 47, No. 10, pp. 9-12.

22. Misra, B.K., Gupta, R.K. and Sewaram, (Apr. 1998) 'Production of Quality Wheat for Varied Domestic Need' , *Indian Farming,* Vol. 48, No. 1, pp. 16-19.

23. Mohmmad Noor, (1997) 'Agricultural Development and Environmental Degration in Sonipat District, Haryana' *National Geographical Journal,* Vol. 43, No. 3, pp. 198-207.

24. Neena, D., (1998) 'Inter State Variation in Cropping Pattern in India' *Indian Journal of Regional science,* Vol. XXX, No. 2, pp. 57-69.

25. Ninan, K.N., (1989) 'Self Sufficiency in Oil Seeds in Grasp and Elusive goal' *Economic and Political weekly,* Sep. 30, Vol. XXIV, No. 39, pp. A133-135.

26. Oche, C.Y., (Jun. 1998) 'Agro-climatic Zonation for Wheat Production in the Savanna Region of Nigeria' *Singapur Journal of Tropical Geography,* Vol. 19, No. 1, pp. 39-550.

27. Peater Bemount, (Apr. 1996) 'Agrculture and Environmental Changes in the Upper Euphretes Catchment of Turkey and Serya and their political and Economic Application' *Applied Geography,* Vol. 16, No. 2, pp. 137-158.

28. Qureshi, A., (1976) 'Food Habits and Deficiency Decease in the District of Agra' *The Geographer*, Vol. XXIII, No. 1.

29. Qureshi, A., (1981) 'Assessment of Potential Productivity of Land in the District of Agra and Mathura' *The Geographer*, Vol. XXIII, No. 2.

30. Sadasivan, Swarna, (1989) 'Pattern of Pulse Production-an analysis of Growth Trend, *Economic and Political Weekly*, Dece. 23-30, Vol. XXIV, No. 51 and 52, pp. A167-A180.

31. Sarkar, R.K. and Chakrabarty, A., (Apr. 2000) 'Biological Feasibility and Economic Viability of Inter-cropping Pulse and Oilseed Crops with Sesame Under Different Planting in Rice-fallow Genetic Alluvial Land' *The Indian Journal of Agricultural Sciences*, Vol. 70, No. 4, pp. 211-214.

32. Sddiq, M.F., (1967) 'Combinational Analysis-a Review of Methodology' *The Geographer*, Vol. XIV, No. 2, pp. 81-99.

33. Shafi, M, (1965) 'Pattern of Crop Land Use in the Ganga-Yamuna Doab' *The Geographer*, Vol. XXIII, No. 2, pp. 13-20.

34. Shafi, M., (1993) 'Ecosystem and Management of Agriculture' *The Geographer*, Vol. XL, No. 2.

35. Shafi, M., (1994) 'Ecology and Land Use/ Cropping System with Special Reference to India' *The Geographer*, Vol. XLI, No. 2, pp-81-84.

36. Shafi, M., (Oct. 1960) 'Masurement of Agricultural Efficiebcy in U.P.' *Economic Geography*, Vol. XXXVI, No. 4.

37. Siddiqi, N.A., (1976) 'Spasio-Temporal Changes in the Crop Land Use Efficiency in the Ganga-Yamuna Doab' *The Geographer*, Vol. XXIII, No. 2.

38. Singh Tapeshwar, (1978) 'Bihar- A Study of Crop Combination Regions' *Indian Journal of Regional Sciences,* Vol. X, No. 2, pp. 145-154.

39. Singh, A.L. and Fazal, S., (1995) 'Factor Accounting for the Change in Area Under Selected Crops' *The Geographer,* Vol. XLII, No. 1, pp. 9-17.

40. Singh, J.P., Prasad, U.K. and Singh, H., (Feb. 2000) 'Effect of Irrigation andf Drainage Requirement on Water Use Efficiency and Yield of Pure and Maize (Zea manys) Based Intercrops' *The Indian Journal of Agricultural Sciences,* Vol. 70, No. 1, pp. 65-68.

41. Sinha, K.S., (Aug. 1998) 'Climate Change and Perspective for Agriculture', *Indian Farming,* Vol. 48, No. 5, pp. 48-51.

42. Smith, Betty, (1994) 'Systematic Descriptive Matrix Analysis of Relationship between Environment and Agriculture' *Singapur Journal of Tropical Geography,* Vol. 15, No. 1, pp. 75-93.

43. Srivastava, A.P , Panwar,J.S. and Garg R.N., (2000) 'Influence of Tillage on Soil Property and Wheat Productivity in Rice (Oryza Sativa) Wheat Cropping System' *The Indian Journal of Agricultural Sciences,* Vol. 70, No. 4, pp. 207-210.

44. Srivastva, C.P., et. al., (Dec. 1998) 'Technology to Step up Fieldpea Production in U.P.' *Indian Farming,* Vol. 48, No. 9, pp. 9-12.

45. Thornthwaite, C.W., (1948) 'An Approach towards Rational Classification of Climate' *The Geographical Review,* Vol. 38, pp. 55-94.

46. Tomar, R.K.S., et.al, (Sep. 1999) 'Prospects of Mustered, the Non-traditional Crop in the Bundelkhand Zone of M.P.' *Indian Farming,* Vol. 49, No, 6, p. 14.

47. Weaver, J.C., (Jan.1954) 'Changing Pattern of Crop Land Use in the Midwest' *Economic Geography,* Vol. 30, pp. 1-47.